Determinants of sexual risk behaviour among HIV-infected individuals across different health service settings in Cape Town

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DECLARATION

I, Kathryn Stinson, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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ABSTRACT

Background Sexual risk behaviour is the underlying driving force of HIV transmission. The discovery and introduction of antiretroviral therapy (ART) has led to significant changes in the treatment and management of HIV, the benefits of which manifest as reduced viral load and consequently attenuated morbidity and mortality in HIV-infected individuals. As the benefits of ART are realized, prevention research is increasingly focusing on the sexual risk behaviour of sub-populations of HIV-infected individuals with known positive serostatus, who are at high risk of transmitting HIV. This study examines the levels of sexual risk behaviour of HIV-infected individuals seeking care across different service settings in Cape Town, South Africa. Furthermore, it seeks to understand the risk factors associated with sexual activity that could lead to secondary transmission.

Methods This cross-sectional study randomly selected 459 male and female clinic attendees aged between 18 and 68 years from two primary health care service settings in Cape Town. All participants were HIV-infected and attending either VCT services, PMTCT services, HIV care or ARV treatment services. Data were collected by means of a structured questionnaire which included items on sexual activity and sexual risk behaviour; socio-demographic characteristics and self-reported health status and well-being. Bivariate and multivariate analyses were performed to determine the levels of sexual activity pertaining to different service settings, and by ARV treatment status. The determinants of sexual risk behaviour in the sample were examined.

Results Higher levels of sexual activity were observed in this setting than those found in similar African settings. No significant differences in sexual activity were found between ARV-treated and treatment naïve participants or across health services. Men were half as likely as women to report sexual activity in the past month and educational level was a positive predictor of decreased sexual activity. Individuals who were on ARV treatment were three times as likely as those not on treatment to have used a condom during their last sexual event. Although they reported lower levels of sexual activity, men were more than three times as likely to report more than one sexual partner in the past six months.

Conclusion In comparison to other research in this area, both in Africa and beyond, the sexual activity and associated risk behaviour among these HIV-infected individuals show both similarities and differences. This underscores the need for tailored policy recommendations and prevention programmes that address context-specific needs of HIV-infected individuals.

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ABBREVIATIONS

ART Antiretroviral therapy
CHC Community health centre
HAART Highly active antiretroviral therapy
HIV Human Immunodeficiency Virus
HRQL Health-related quality of life
HSRC Human Sciences Research Council
IMR Infant mortality rate
MOU Midwife obstetric unit
MSM Men who have sex with men
PMTCT Prevention of mother-to-child transmission of HIV
SADHS South African Demographic and Health Survey
STI Sexually transmitted infection
UAI Unprotected anal intercourse
VCT Voluntary counselling and testing
WHO World Health Organisation

1 INTRODUCTION

An estimated 2 million deaths due to AIDS occurred in 2007; 75% of these occurred in sub-Saharan Africa (UNAIDS, 2008). While HIV prevalence is reported to be stabilizing on the African continent, AIDS remains the leading cause of death (UNAIDS, 2008). Southern African countries bear the heaviest disease burden, with 35% of all new infections and 38% of all AIDS-related deaths occurring in this region in 2007 (UNAIDS, 2008, UNAIDS and World Health Organisation, 2007). South Africa has the largest number of HIV infections in the world, with a national antenatal seroprevalence of 28% in 2007 (Department of Health, 2007). Prevalence has been estimated by UNAIDS to be as high as 17% in females aged 15-24 years in 2007 (UNAIDS, 2008).

There is considerable geographic variation in the distribution of HIV. The differential global trajectories of the epidemic can be explained to a great extent by the differences in transmission dynamics which are primarily driven by sexual risk behaviour. Sexual risk behaviour constitutes a constellation of sexual practices which are deemed "unsafe", consequently placing an individual at risk of acquiring infection. Risk is modified by the presence and extent of several behavioural dimensions including the number of sexual partners acquired; the characteristics of these sexual partners and the nature of such partnerships; the frequency and mode of sex acts. Protective behaviours which mitigate risk include the frequency of protected sexual intercourse through barrier method use (Aral, 2004, Aral et al., 2007, Slaymaker, 2004).

Sexual risk behaviour varies at population and sub-group level, hence it changes between contexts and over time. Populations are heterogeneous, each with structural and individual-level features that contribute to differential settings for the transmission of HIV (Aral et al., 2007). Despite this variation, sexual risk behaviour is the universal and underlying driving force of HIV transmission, with approximately 85% of all current infections being attributed to sexual transmission (Piot et al., 2008). While initial prevention efforts targeted those at high risk of acquiring HIV, more recently the focus has shifted to identifying and understanding the sexual risk behaviour of sub-populations of HIV-infected individuals with known positive serostatus, who are at risk of transmitting HIV, with a view to developing more serostatus-specific prevention interventions (Crepaz and Marks, 2002).

Early research in high risk sub-populations in developed country settings initially confirmed speculation surrounding the association between increased sexual risk behaviour and widespread antiretroviral (ARV) treatment initiation in men who have sex with men (MSM). Observed behavioural change was referred to as 'treatment optimism', and it was based on the premise that advances in treatment options for HIV-infected individuals as well as evidence that ART

(antiretroviral therapy) improves and prolongs life, could lead to complacency around safer sexual practices (Ciesielski, 2003). Since then however, these findings have been challenged in light of accumulated evidence of discrepant associations between increased sexual activity and assumptions concerning treatment optimism in developed settings. Much of this discrepancy can be attributed to the complexity of the association between sexual risk behaviour and HIV transmission across locations which are a result of the underlying heterogeneity of populations experiencing HIV epidemics. Furthermore, there is evidence to suggest that increases in sexual risk behaviour have occurred independently of the perception that ART mitigates the risk and consequences of HIV transmission (Elford, 2006, Grassly et al., 2001).

The discovery and introduction of antiretroviral therapy in 1996 heralded significant changes in the treatment and management of HIV, the benefits of which manifested as reduced viral load and consequently attenuated morbidity and mortality in HIV-infected individuals (Quinn, 2008). In particular, while HIV is increasingly becoming manageable as a chronic illness, both long-and short-term clinical and socio-behavioural improvements in health-related quality of life (HRQL) in individuals who are on ART are being observed (Jelsma et al., 2005a, Protopopescu et al., 2007).

Although research into the HRQL of individuals on ART has been carried out in developing countries, the impact of improved prognosis after treatment initiation on sexual risk behaviour in developing country settings is less well understood. The mix of transmission dynamics involving predominantly heterosexual high risk behaviour, delayed treatment roll out as well as limited coverage and access to care underscore the differential impact of treatment on secondary transmission between HIV negative individuals and those of known positive serostatus in these settings (Quinn, 2008).

With many treatment programmes still in their infancy, little is known about the short-term effect of ART on sexual risk behaviour in developing countries (Kennedy et al., 2007, Salomon and Hogan, 2008). South Africa is no exception. While ART has been made available since 2004, roll out of programmes and treatment scale-up has not happened uniformly across provinces. Access to treatment has been hampered by a mix of health system challenges, including service- and patient-driven factors (Johnson, 2007). While perceptions and behaviour surrounding sexual risk seem to be positively influenced by the introduction of improved HIV testing and ART services in local settings, HIV transmission rates have been reported to continue to rise unabated. Despite good coverage and awareness of HIV prevention interventions, high rates of sexual risk behaviour are still observed (Boulle et al., 2008, Hendriksen et al., 2007, Shisana et al., 2005, Versteeg and Murray, 2008). Evidence from recent South African research suggests that the prevalence of sexual risk practices among HIV-infected sub-populations may be no different (Eisele et al., 2008).

Furthermore, as life expectancy of HIV-infected individuals is extended due to the effect of treatment, so new interest in the health-related quality of life of HIV-infected individuals has been generated, not least amid concerns about increased behavioural 'disinhibition', suggesting that individuals receiving ART might engage in riskier sexual behaviour than they would have if they were not on ART, if they believe that by being on ART, they are reducing their own infectivity through lowered viral load (Elford, 2006, Elford et al., 2002). With increasing numbers of HIV-infected individuals moving onto treatment and living healthier and longer lives, so the study of sexual health and behaviour among these individuals and factors which increase risk of transmission to their partners of HIV-negative or unknown status (known as secondary transmission) has become increasingly important to inform policy and prevention.

The aim of this study is to examine the levels of sexual risk behaviour of HIV-infected individuals attending voluntary counselling and testing (VCT), prevention of mother-to-child transmission (PMTCT), HIV care and antiretroviral (ART) treatment services in Cape Town, South Africa. More specifically, it seeks to understand the risk factors associated with sexual activity (defined per study protocol as penetrative vaginal or anal intercourse) that could lead to secondary transmission. Since data is sourced from respondents attending distinct services, it is possible to investigate the potential variation in sexual risk behaviour across different service settings. In particular, having four service settings to hand provides an opportunity to examine potential differences in sexual risk behaviour between those who have been recently diagnosed (PMTCT and VCT services) and those who have had longer exposure to care (HIV and ART services). Finally, the study seeks to examine the association between improved health-related quality of life and sexual risk behaviour. The following research questions are posed:

1. What are the levels of sexual activity and different forms of sexual risk behaviour among HIV-infected individuals either accessing ART treatment or other HIV-related services?
2. What are the determinants of sexual activity in HIV-infected individuals?
3. Which factors are associated with unprotected sex and barrier method use, and multiple partner acquisition among sexually active HIV-infected individuals?
4. Is there an association between being on ARV treatment and sexual risk behaviour?
5. Is the time since HIV diagnosis, or disclosure status or health-related quality of life correlated with sexual risk taking in HIV-infected individuals?

As ART becomes increasingly available in South Africa, so it becomes imperative to understand the sexual risk behaviour of HIV-infected individuals in order to design prevention programmes that

effectively target individuals of known positive serostatus who are at risk of secondary transmission to individuals of negative or unknown HIV status.

2 LITERATURE REVIEW

2.1 The epidemiology of HIV in South Africa

In South Africa, HIV was first introduced into the heterosexual population through cross-country migration patterns in the Southern African region (Williams and Gouws, 2001). In 1990, South African HIV prevalence among women attending antenatal clinics was 0.7% (Department of Health, 2008). Doubling time at the start of the epidemic was approximately 15 months, and by 1994 antenatal clinic HIV prevalence had increased to 10%, indicating a rapid spread from high-risk groups to the general population (Williams et al., 2000). Antenatal clinic data showed a continued rise in prevalence which has currently levelled off at 28% (Department of Health, 2007).

Factors facilitating early spread included circular migration patterns of labour and the high prevalence of curable and incurable STIs in urban and rural populations (Williams and Gouws, 2001). The seasonal migrant labour system linked to the South African gold mines drew a substantial work force from neighbouring countries as well as workers from within South Africa. Single-sex hostel dwelling for periods of up to six months placed migrant workers at high risk of STIs and HIV acquisition through commercial sex, followed by transmission to stable sex partners upon returning home (Lurie, 2000, Campbell, 2003). High prevalence of bacterial and viral STIs in sentinel populations, including antenatal and STI clinic attendees and sex workers, were indicated by the limited access to treatment services and poor diagnosis and management of STIs, rendering high risk groups more vulnerable to HIV transmission (Johnson, 2007, Johnson et al., 2005).

A mix of biological, social and economic factors has ensured that women have borne the highest burden of infection in South Africa. As the epidemic entered a mature stage after 2000, women aged 15-49 years were estimated to account for 49.5% of all infections (Dorrington et al., 2002). Socio-demographic disparities by age and sex continue to be marked: 37% of all new infections occurred in adults between 15-24 years in 2007, with HIV prevalence among males in this age group being 4%, yet 22% among females in the same age group (UNAIDS, 2008).

2.2 Sexual risk behaviour as a determinant of HIV transmission

Mathematical models and epidemiological studies on HIV transmission have done much to explain changes in transmission dynamics and sexual risk behaviour across settings and over time (Aral et al., 2005, Cassels et al., 2008). The transmission dynamics of HIV, as applied to other sexually transmitted infections (STIs), are determined by three biological and behavioural mechanisms: the

average rate of contact between infected and susceptible individuals, the efficiency of transmission from infected individual to susceptible partner, and the average duration of infectiousness (May and Anderson, 1987, Royce et al., 1997).

Contact rates are dependent on both the rate of partner acquisition and the frequency of sex within partnerships, yet sexual partnerships and the probability of HIV transmission do not occur at random. They are, rather, dependent on an array of political, economic, cultural, geographical factors, as well as those relating to health service delivery. Consequently the social patterns and sexual behaviour of some individuals contribute more to the spread of HIV than others (Day et al., 1998). "Core groups" or vulnerable sub-populations comprising sex workers, men who have sex with men (MSM), truck drivers or migrant labourers have been identified as major role players in spreading and sustaining HIV epidemics. As high risk transmitters, their sexual behaviour is characterised by elevated rates of partner acquisition and high frequency of sex acts (Thomas and Tucker, 1996). In settings where rates of sexual risk behaviour are low in the general population, infection is likely to increase exponentially within core groups. Such sexual activity either results in a locally concentrated epidemic that remains within the core group or a truncated epidemic, which shifts to low risk sub-populations as a consequence of individual movement from the core group to stable sexual partnerships (Aral et al., 2007).

The role of mixing patterns or sexual networks is another feature of contact-related transmission. Such networks "bridge" core groups with low risk peripheral sub-populations and have the potential to increase general population prevalence. Once population prevalence is exceeds 1% in adults aged 15-59 years, and 5% in core groups, the epidemic moves to a generalized state. In such settings prevalence remains disproportionately higher in core groups, but is maintained through widespread sexual risk behaviour in the general population (Hellringer and Kohler, 2007, UNAIDS, 2008).

Demographic and health survey data have shown that individuals in sub-Saharan Africa are more likely to have concurrent rather than multiple serial partners than people in other parts of the world (Garnett and Johnson, 1997, Halperin and Epstein, 2004). However, evidence from a study in 5 African cities found no association between concurrency and HIV spread (Lagarde et al., 2001). Mathematical models of the spread of HIV have estimated that the potential effect of concurrency on disease transmission is considerable even when the average frequency of partner change remains constant. Since concurrent relationships can be viewed as small networks, members are at a higher risk of infection than if they were serially monogamous (Morris and Kretzschmar, 1997).

Substantial variation in the risk of transmission has been associated with duration of infectiousness, disease stage and viral load (Pilcher et al., 2004). Higher infectivity during acute

infection has been associated with a twelve-fold increase in the probability of infection due to peak viral load, while late stage infection has been associated with an approximately fivefold increase in the transmission risk (Wawer et al., 2005). The combined effect of acute infection in concurrent networks may amplify transmission through chains of sexual partnerships incorporating newly infected individuals and susceptibles (Morris and Kretzschmar, 1997).

Transmission risk is further elevated in the presence of other STIs, which biologically interact with HIV to increase both infectiousness and susceptibility (Low et al., 2006). Although reciprocity is lower in non-ulcerative STIs, transmission rates are higher due to higher prevalence of non-ulcerative STIs in most populations affected by HIV. With ulcerative STIs, transmission is bi-directional (Fleming and Wasserheit, 1999). In particular, the risk of acquiring HIV is two to three times higher in the presence of herpes simplex virus type 2 (HSV-2) co-infection (Freeman et al., 2006, McClelland et al., 2002, van de Perre et al., 2008, Wald and Link, 2002, Wasserheit, 1992) .

2.3 Determinants of sexual risk behaviour

The intrinsic driver of differential disease spread within populations is sexual risk behaviour. Much has been written about sexual networks and the strong association between gender, poverty and the high prevalence of transactional sex and age-mixing in South Africa, which highlights the biological and social pre-disposition of younger women to infection (Dunkle et al., 2004, Leclerc-Madlala, 2008). In the 2005 Human Sciences Research Council (HSRC) national household survey, one third of females reported to have had partners who were at least 5 years older than themselves (Shisana et al., 2005). Multiple partnerships and partner concurrency in South Africa are also considered significant factors in the transmission of HIV and other STIs (Johnson, 2007). In a recent household study of kwaZulu-Natal adults aged 15-49 years, 65% of men who had two or more partners in the past three years reported themselves to be in concurrent relationships, 19% reported concurrency in women who had two or more partners in the past three years (Harrison et al., 2008). A cross-sectional survey of Khayelitsha residents in Cape Town reported that 29% of men and 8% of women had been involved in a sexual relationship outside of their current sexual partnership in the previous year. Men also reported that on average, their current partner was 4.4 years younger, while men over 40 years reported sexual partners who were on average 7 years younger than themselves (Boulle et al., 2008). Data from the 2003 South African Demographic Health Survey (SADHS) showed a linear relationship between an increase in the number of partners over the past year and increased level of education, among both men and women, thus suggesting that individuals with a higher education are more likely to be employed, and thus are at increased risk of HIV through a disposable income (Department of Health et al., 2007).

Condoms provide the most effective barrier method in HIV and STI prevention, however, evidence shows that condom use is predicted by many factors including age, sex, relationship status, exposure to media campaigns and cultural views (Katz, 2006, Katz and Low-Beer, 2008). While South African research has shown encouraging levels of condom awareness and accessibility, condom utilization has been reported to be insufficient to curb the spread of HIV (Hendriksen et al., 2007). In a nationally representative sample of South African youth conducted in 2007, the strongest predictor of condom use at last sex was whether or not respondents had used a condom at sexual debut. Other predictors of condom use at most recent sex included high condom use self-efficacy, behaviour change related to increased HIV awareness, and optimism about the future. Decreased condom use at last sex was associated with marriage and relationships of more than 6 months in duration (Hendriksen et al., 2007). The 2005 HSRC national household survey reported 72% and 55% condom coverage in males and females aged between 15-24 years respectively. Among those reporting more than one concurrent partner, 60% of participants reported condom use at last sex (Shisana et al., 2005). In a household survey in Khayelitsha, Cape Town, 41% of male respondents and 33% of female respondents reported to have used a condom at last sex (Boulle et al., 2008). Qualitative studies in South Africa have documented barriers to consistent condom use, which include reported reduction in sexual pleasure, distrust in the efficacy of condoms and fear of potential side effects. Inconsistent barrier method use in this context has also been ascribed to cultural reasons, as well as the difficulties associated with condom use within long-term relationships; the subsequent implications on partner trust and the threat of derision by peers (Gibson and Nadasen, 2007, Versteeg and Murray, 2008).

South African research has also shown an association between disclosure status and sexual risk behaviour. In a study of HIV-infected women and men accessing HIV services, a high proportion stated that they were sexually active and 42% of these respondents stated that they had not disclosed their HIV status to a sexual partner in the past three months. Failure to disclose one's status was associated with an increased risk of multiple partner acquisition, as well as having an HIV-negative partner or a partner of unknown status (Simbayi et al., 2007). Another community survey of rural and urban HIV-infected South African respondents showed that disclosure was associated with reduction in multiple sexual partnerships and monogamy and an increase condom use (Wong et al., 2009).

Sexual violence against women is also a risk factor for HIV transmission in South Africa. In a survey of men attending Cape Town STI services, those who had a history of sexual assault were more likely to have a history of multiple partners, genital ulcers and engaged in commercial sex (Simbayi et al., 2006). Similarly, the association between substance abuse and increased sexual risk is

well known. In Cape Town survey of STI clinic attendees, excessive alcohol use was associated with higher rates of sexual risk behaviour (Simbayi et al., 2004). High rates of unprotected sex (80%) with partners who were either HIV-negative or of unknown status were associated with moderate to high risk alcohol consumption in a sample of HIV-infected individual drawn from Cape Town HIV services (Kiene et al., 2008).

2.4 Prevention of primary and secondary transmission of HIV

Longstanding HIV primary prevention efforts in South Africa (as in other parts of the world) have mostly concentrated on structural and behavioural change. Structural approaches towards the social and economic empowerment of South African HIV-infected and non-infected women are ongoing and need further evaluation (Rao Gupta et al., 2008). Behavioural change programmes have used education and mass media to promote delayed sexual debut, decreased multiple sex partners, protected sex and HIV testing and continued adherence risk reduction behaviour (Coates et al., 2008, Harrison et al., 2000). Evidence of success has been recorded by increased condom use among 15-24 year old respondents in the HSRC national household surveys between 2002 and 2005. Trends in sexual partnerships and frequency of sexual intercourse, however, remained largely unchanged (Shisana et al., 2005).

Most behavioural efforts are applicable to and have been effective in targeting secondary transmission among HIV-infected individuals of known serostatus. In particular, prevention campaigns have focused on the importance of HIV testing and safer sexual behaviour to limit secondary transmission. In the 2005 HSRC household survey, condom use with non-regular partners was higher among HIV-infected respondents than among those who were known to be seronegative. However, having multiple partners was associated with higher HIV prevalence and increased condom use and hence could be a potential confounder (Shisana et al., 2005).

Recent prevention strategies have turned to biomedical and treatment intervention as a means of curbing both primary and secondary spread. Biological primary prevention strategies to date have included microbicide and vaccine research (Padian et al., 2008). Microbcides consist of a variety of antimicrobial agents to be used pre-coitally per vagina or rectum. Initially conceived as a female-controlled intervention and then used in MSM, early research heralded microbicide interventions as promising, however, over the past decade, the results on the efficacy of microbicides in prevention trials have been discouraging (Padian et al., 2008). The spermicide, Nonoxynol-9, was shown to have no protective effect on HIV transmission in a multi-country trial among sex workers (Van Damme et al., 2002). Outcomes from the phase III trial of the entry/fusion inhibitor, Carraguard, showed no significant differences in male to female transmission of HIV between intervention and placebo

groups(Skoler-Karpoff et al., 2008). Current research is moving towards the use of ARV compounds; long-acting preparations and combination products (Padian et al., 2008).

.Vaccine research for the prevention of HIV transmission has been unsuccessful to date, due to the genetic variability of HIV and its capacity to evade the neutralising antibodies contained in vaccines (Padian et al., 2008).

Male circumcision is another approach which is being heralded as both a primary and secondary prevention strategy. The results of three recent clinical trials have demonstrated the protective effect of male circumcision on HIV transmission in men (Auvert et al., 2005, Bailey et al., 2007, Gray et al., 2007). While male circumcision is protective for men due to cutaneous barrier change which reduces the risk of access to receptive cells for both HIV and other ulcerative STIs, the effect of male circumcision on HIV transmission in women and among MSM is not well understood. Furthermore this intervention has profound cultural implications in South Africa, and risks of complication which need to be considered before widespread implementation is feasible in local settings (Cohen, 2000, Titus and Moodley, 2008).

Treatment strategies such as the syndromic management of STIs at public health facilities have had mixed successes. From the earliest research into South African high risk groups, a strong correlation between HIV and STI co-infection has been recorded (Williams and Gouws, 2001). While treatment protocols may explain declining trends in the prevalence of syphilis, drug shortages and heavy patient loads are reported to hamper coverage (Johnson, 2007). Yet, management of STIs on an individual and population level is complex. This is illustrated in well-documented evidence from three landmark intervention trials in Mwanza, Tanzania and Rakai, Uganda that showed the effect of sexual behaviour change on the effectiveness of STI treatment in the prevention of HIV (Grosskurth et al., 1995, Kamali et al., 2003, Wawer et al., 1999). These studies, which were conducted at radically different stages of the HIV epidemic, highlighted the importance of primary prevention intervention strategies to reduce sexual risk behaviour for concentrated epidemics and the need for different approaches, including increased VCT coverage; health education on treatment options for those infected and a focus on prevention in stable partnerships, to prevent secondary transmission in generalized epidemics where behaviour change had already occurred or was occurring (Korenromp et al., 2005).

Hence an understanding of the evolution of transmission dynamics and sexual risk behaviour and temporal effects on epidemic stages has been shown to be crucial in the planning and timing of HIV prevention interventions. More recently in the face of generalized epidemics, prevention programmes have shifted focus away from primary prevention in uninfected high risk groups, to secondary prevention approaches to reduce HIV transmission between those with known

seropositive status and their partners who either are not infected, or are of unknown status. The motivation for moving from protecting individuals from acquiring HIV to incorporating the prevention of transmission from infected individuals has largely stemmed from the advent of antiretroviral therapy (ART) and the clinical evidence of its benefits. Since individuals who are on ART are living longer and healthier lives, so prevention efforts which focus on their sexual health and behaviour have been recognised as important (Coates et al., 2008, Elford, 2006).

2.5 Changing patterns of sexual risk behaviour in the era of antiretroviral therapy

Advances in treatment in the era of ART have resulted in dramatic clinical benefits and improved patient outcomes in settings with universal access to treatment (Quinn, 2008). AIDS mortality has declined in settings where ART has been made widely available and treatment has been associated with significant decreases in log viral load, improved survival and enhancement of quality of life (Kravcik et al., 1998). Mathematical models of the impact of ART have shown significant reduction in HIV incidence up to 50% over 10 years in best-case scenario simulations where widespread treatment was rapidly initiated in early disease stage by all HIV-infected individuals (Garnett et al., 2002). Simulation of the South African epidemic, where treatment initiation criteria dictate that only a small proportion of infected individuals receive ART, predicts little direct impact of ART on HIV incidence but a significant increase in the HIV prevalence pool over time due to the prolongation of life (Johnson and Dorrington, 2006).

2.5.1 Health-related quality of life

With HIV increasingly being perceived as a manageable chronic disease, so an interest in the health-related quality of life (HRQL) of HIV-infected individuals has been cultivated. HRQL covers a broad range of physical and psychological characteristics which dictate an individual's capacity for daily functioning and satisfaction in the context of a particular health state being experienced (Tsasis, 2000). Specific measures of HRQL which incorporate a spectrum of mental, physical, functional and social domains have been developed, validated and applied to HIV-related studies across settings (Clayson et al., 2006, Huang et al., 2008). Prospective studies have focused on the long term benefits of ART, while cross-sectional studies have compared the HRQL of individuals on ART to those not on ART in the same setting. Other studies have compared HRQL differentials across gender and other vulnerable groups with the aim providing improved treatment and care services (Rao et al., 2007). While it has been found that lower scores of HRQL are recorded among HIV-infected individuals than in the general population, ART has the potential to improve these scores within the first year of treatment (Hughes et al., 2004, Miners et al., 2001).

The long term benefits of ART have been documented in Europe in a 5-year follow up study of a French cohort on treatment confirmed previous findings of improved HRQL within the first six months to a year of treatment initiation. A lower CD4 cell count was associated with initial lower physical and mental scores, possibly due to faster disease progression among these individuals. The study showed that these scores improved over time, demonstrating the efficacy of ART. Furthermore, treatment side effects were associated with impaired daily functioning. However, adaptation to the side effects of treatment over time led to improved scores. Socio-demographic factors positively associated with better mental and physical well-being included being younger and having no children to look after. Also, improved mental health was associated with being male, MSM, and having a stable partner and self report of fewer physical and metabolic symptoms of illness, for example, lipodystrophy (Protopopescu et al., 2007).

Two studies in the Free State province and one study in the Western Cape, South Africa have reported improved HRQL measures in patients within the first year of treatment initiation (Louwagie et al., 2007, Wouters et al., 2007). Modelled data from a longitudinal study of patients enrolled with at least two months treatment experience, predicted that improvements in physical HRQL were positively associated with being male, higher education and initial months of ART treatment. A positive association between improved emotional HRQL and being on treatment was also observed. Patients receiving treatment also reported significantly higher levels of emotional HRQL than those still awaiting treatment. Physical improvements in HRQL were seen to mediate the association between emotional well-being and treatment status (Wouters et al., 2007). A cross-sectional study of patients waiting to initiate ART and patients who had been on ART for under 90 days, sampled from the same patient population that used by Wouters et al, showed respondents on ART were significantly less likely than those awaiting ART to report high problem scores on all the domains of the HRQL measure. Interestingly, being female and being employed were independent positive predictors of higher self reporting of HRQL scores (Louwagie et al., 2007). In a different study, in Cape Town (Jelsma et al 2005b), patients receiving treatment for 12 months in three public sector clinics, also showed linear improvements in their health states over time, with self-reported well-being scores contributing to 50% of total improvement in the first month of treatment initiation (Jelsma et al., 2005b).

Scant evidence exists on the association between HRQL and the sexual health and activity of HIV-infected individuals, either on treatment or not. A nationally representative study of French men and women with HIV showed that sexual difficulty was associated with lower levels of sexual activity. Furthermore, both HIV-related symptoms, as well as HIV treatment were associated with sexual difficulty (Bouhnik et al., 2008).

2.5.2 Voluntary counselling and testing

The advent of ART, its perceived benefits and efforts to extend universal access to treatment, has resulted in increasing numbers of people accessing HIV testing and care (UNAIDS, 2008). Hence this is seen as an opportunity to intensify secondary prevention efforts through increasing the proportion of infected individuals with known - as opposed to unknown - positive serostatus at population level. Some research has shown a link between certain measures of risk reduction post-HIV testing among HIV-infected and HIV-uninfected individuals. In a meta-analysis of studies of the effect of VCT in developing countries between 1990 and 2005 (Denison et al., 2008), a significant association between recent VCT and a decrease in unprotected sex when compared to behaviour prior to testing, or to respondents who had not undergone VCT. In this meta-analysis, however, VCT had no significant impact on number of sexual partners post-counselling and testing (Denison et al., 2008).

In another study of 66 newly-infected MSM from seven cities in the United States, reduction in unprotected anal intercourse (UAI) was evident after receipt of diagnosis, however, these individuals were not seen to engage in lower risk sexual behaviour in the 12 months of follow up post diagnosis, indicating a reduction of frequency, but not degree of risk in sexual behaviour (Coldfax et al., 2002). A meta-analysis of studies in American settings examined the sexual risk behaviour among HIV-infected individuals who knew their status and others who did not know their status. In a pooled analysis of 11 studies, the prevalence of unprotected anal or vaginal intercourse was significantly less among HIV-infected individuals who were aware of their seropositive status than in HIV-infected individuals who were not aware of their seropositive status, with a combined effect size across all studies being a 53% reduced risk of sexual risk behaviour in those aware of their seropositive status (Marks et al., 2005).

Evidence from developing contexts is sparse. In a cohort study of Zimbabwean men and women, VCT uptake was associated with a significant reduction (approximately half) in the number of partners in the past year in HIV-infected respondents. At one year follow up, consistent condom use over the previous two weeks was significantly associated with VCT in HIV-infected women in this study (Sherr et al., 2007).

A South African cross-sectional study of HIV-infected respondents of known positive serostatus attending HIV care services, suggested significant differences between urban and rural residents regarding sexual risk behaviour. Urban residents were more likely to be currently sexually active (OR: 2.9, $p=0.001$) and to be in regular sexual partnerships (OR: 3.53, $p<0.001$) than their rural counterparts. Urban residents were more likely to report consistent condom use with both regular partners (OR: 3.89, $p<0.001$) and casual partners (OR: 2.337, $p<0.001$) than their rural

counterparts, suggesting the importance of targeting prevention efforts in rural areas in South Africa (Lurie et al., 2008).

2.5.3 Treatment optimism

Concerns about the unintended effects of treatment on elevated sexual risk behaviour in HIV-infected individuals have been tested in observational research. Such studies were based on the assumption that community perceptions of reduced infectiousness and improved survival associated with treatment efficacy, would lead to increased levels of sexual risk behaviour among high risk groups regardless of sero- or treatment status. This phenomenon is denoted in the literature as 'behavioural disinhibition' or 'treatment optimism' (Crepaz et al., 2004b).

2.5.4 Developed country research

Early studies of treatment optimism which were carried out in developed contexts with well-functioning ART treatment and care services, largely focused on sub-populations of seropositive and seronegative MSM, and produced conflicting results. For example, a study of American male and female clinic attendees accessing ART, demonstrated a significant association between optimistic treatment-related beliefs and unprotected sex in non-concordant partnerships. Findings from this study suggested that perceptions of the preventative efficacy of ART existed regardless of log viral load among discordant couples (Kalichman et al., 2006). Furthermore, a longitudinal study (1999-2002) of Dutch seronegative MSM practicing regular high risk sexual behaviour found a significant association between the beliefs in reduced threat of HIV/AIDS since the advent of ART and changes from protected to unprotected receptive anal intercourse (Stolte et al., 2004). However, a series of cross-sectional studies between 1998-2001 of MSM attending London gymnasiums and of mixed and unknown HIV serostatus, found no association between increased rates of high risk sexual behaviour and treatment optimism, and no differences in sexual behaviour were detected among men who were optimistic about ART and men who were not optimistic about ART, over time (Elford et al., 2002)

Another cross sectional study of HIV-infected MSM attending an outpatient clinic examined rates of high risk sexual behaviour between respondents on ART and respondents not on ART. In crude analyses, men on ART reported significantly fewer new partners in the previous year than men not on ART and lower frequency of UAI with 1 or more partners in the previous year than men not on ART. These results suggested that while high risk sexual behaviour was still prevalent among HIV-infected individuals, frequency and level of risk behaviour was less among those on ART (Stephenson et al., 2003).

A meta-analysis of 21 studies undertaken in Europe and the United States that examined the association between unprotected sexual intercourse or STIs as a proxy for sexual risk behaviour and being on ART, showed no significant difference in sexual risk behaviour between HIV-infected individuals on ART and those not on ART . However, an interesting finding in this review, which incorporated a further 11 studies (including the abovementioned two studies on treatment optimism) on attitudes of HIV-infected and HIV-negative individuals, was a significant positive association between elevated sexual risk behaviour and beliefs held by infected and uninfected individuals alike, that treatment and decreased viral load was protective against HIV transmission (Crepaz et al., 2004a).

A more recent study in France concurs with the above evidence that treatment is not associated with elevated sexual risk behaviour in HIV-infected individuals. In a study of heterosexual sero-discordant couples, risky sexual behaviour was associated with duration of relationship, being under the age of 40 years, financial difficulty and excessive alcohol consumption in men. A history of substance use, financial difficulty and lack of awareness of a partner's serostatus and difficulty in negotiating condom use was significantly linked to increased sexual risk behaviour in women. Of the participants, 80% were on ART, while 69% had an undetectable viral load, however, neither of these variables was associated with sexual risk behaviour (Bouhnik et al., 2007).

2.5.5 Developing country research

Evidence on the association between sexual risk behaviour and treatment from developing country settings is limited, due to ART programmes being still in their infancy; the different transmission dynamics of HIV operating within mature epidemics, which require specific programmatic prevention and control measures, and a lack of widespread access to antiretroviral treatment for those in need (Kennedy et al., 2007, Salomon and Hogan, 2008). In a multi-centre cross-sectional study of Brazilian HIV-infected men attending HIV care who engaged in high risk anal or vaginal sexual activity, showed in univariate analyses that not being on ART was associated with inconsistent condom use in the previous year, however, this finding was statistically insignificant (OR: 1.6, 95% CI: 0.9-2.1). In this study setting drug use, having stable partners, the number of female partners and having an STI were significant correlates of unsafe sexual behaviour (Guimaraes et al., 2008).Evidence from research into sexual risk behaviour and secondary transmission of HIV is beginning to emerge from settings in Africa. A systematic review of the impact of HIV treatment on sexual risk behaviour by Kennedy et al (2007) reported three African studies which indicated significant reductions in sexual risk behaviour in HIV-infected individuals on ART (Kennedy et al., 2007). First, in a cross-sectional survey of 711 HIV-infected individuals attending services in two cities in Côte d'Ivoire, results showed low frequencies of sexual risk behaviour among respondents,

with high levels of abstinence. Frequency of sexual activity was higher among men than among women; and not being on ART was significantly related to higher levels of risky sexual activity among those who were sexually active. Respondents on ART were approximately half as likely to engage in sexual risk behaviour as those who were not on ART (OR: 0.52, 95%CI: 0.29-0.93). In bivariate analyses, a significantly higher proportion of untreated HIV-infected respondents had engaged in casual sexual intercourse at their last sexual act (no OR specified, p=0.02) and significantly fewer respondents on ART had unprotected sexual intercourse at last sexual act (no OR specified, p=0.001). The authors argue that the reason for these results could be attributable to the increased promotion of safer sexual behaviour practices which offered by health care staff to those accessing ART. Furthermore, the study was carried out within 18 months of treatment roll out, hence it is possible that the results reflect only the short term impact of ART and treatment care on sexual risk behaviour (Moatti et al., 2003).

Second, a cross-sectional survey of HIV care among male and female attendees at a clinic in Kampala, Uganda showed no association between increased sexual activity and being on treatment, but rather significant reductions in some sexual risk behaviours among those on ART, compared to those not on ART. For married respondents, ART-treated attendees were more likely to have disclosed their serostatus to a spouse than treatment naïve respondents (OR: 1.57, 95% CI: 1.07-2.30). While rates of consistent condom use were high overall among respondents for spouse, regular and commercial partners, respondents on ART reported significantly higher rates of consistent condom use in spousal relationships than respondents not on ART (OR: 2.82, 95% CI: 1.74-4.6). ART-treated respondents were significantly more likely to report condom use at last sexual intercourse with a regular partner than respondents not on ART. Respondents on ART were significantly more likely to report with an STI than non-ART respondents (Adjusted OR: 2.6, 95% CI: 1.77-3.82), however, this result could be due to increased opportunity and methods for diagnosis and treatment through regular contact with ART services. While over half of the sample was not sexually active, ART-treated respondents were more likely to be sexually active (OR: 1.35, 95% CI: 0.99-1.82), however, overall this study did not find an association between ART treatment and risky sexual behaviour in the previous 6 months. This study measured physical attributes of HRQL, and found that ART-treated respondents reported significantly higher physical well-being after a mean treatment duration of 1.6 years, than ART-naïve respondents (p>0.0001) (Bateganya et al., 2005).

A third study in rural Uganda showed promising reductions in sexual risk activity among patients on ART. A prospective cohort of HIV-infected adults with advanced stage disease, was followed up after 6 months experience of a home-based ART treatment programme. Sexual abstinence was high at baseline, with 53% of men and 79% of women reporting no sexual activity in

the previous 3 months. Of those who were in stable partnerships, 65% of men and 59% of women reported being sexually active in the past 3 months. Of those who were not in stable partnerships, 13% of men and 9% of women reported sexual intercourse in the past 3 months. Among all the sexually active respondents, 44% of men and 45% of women reported unprotected sex with at least one partner. While the percentage of respondents who had been sexually active at baseline did not change significantly among men (p=0.2243) or women (p=0.1772) at follow up, significant decreases in unprotected sex (AOR: 0.5, 95% CI: 0.3-0.8) and unprotected sex with a negative or unknown partner (AOR: 0.4, 95% CI: 0.2-0.6) were noted among all respondents. Within stable partnerships, increases in consistent condom use with partners of negative or unknown status (p=0.0003), as well as an increase in condom use within concordant partnerships (AOR: 2.2, 95% CI: 1.4-3.7). Investigators found that over 85% of reported sexual risk behaviour occurred between married and cohabiting couples, however, overall sexual activity was low from baseline. It is unclear as to the effect prevention activities which were a mandatory part of the study, as well as self-reporting bias may have had on these promising results of risk reduction in ART-initiated respondents (Bunnell et al., 2006).

Contrary to these results, another recent prospective study of treated and untreated HAART patients enrolled in HIV care services, Côte d'Ivoire, showed an increase in sexual risk behaviour at 6 month follow in the treatment group. Interestingly, at baseline, those who did not receive ART reported higher rates of unprotected sexual intercourse compared to those who started treatment (RR: 1.25, 95% CI: 1.05-1.49). Significant increases in unprotected sexual intercourse in the treatment group by 6 months follow up (RR: 1.40, 95% CI: 1.21-1.61) and stability among the untreated group (RR: 1.07, 95% CI: 0.94-1.20) suggests strong association between ART treatment and increase in sexual risk. However, investigators maintain that this sexual risk was contained in stable partnerships, and the median number of partners did not increase over time. This has specific implications for secondary transmission within discordant stable partnerships (Diabate et al., 2008).

Another prospective study in Kenya, however, showed a decrease in sexual risk behaviour in a cohort of clinic attendees at 12 month post-ART initiation follow up. At baseline, approximately half the sample was sexually active, and half of these respondents reported engaging in unsafe sex. After twelve months of treatment, 28% of those who reported sexual activity were practicing risky sexual behaviour. Unsafe sex was associated with non-disclosure, recent diagnosis, not being in a cohabitational relationship or marriage, and stigma, depression and a body mass index $<18.5 kg/m^2$ (Luchters et al., 2008).

The mixed results of the studies conducted in African contexts do not indicate consistent patterns in sexual risk behaviour, these discrepancies yet again serving to emphasize the uniqueness

of sexual risk behaviour and transmission dynamics across contexts. Furthermore, these results imply the need for country-specific prevention programmes.

In conclusion, the field of secondary prevention of HIV in light of sexual risk behaviour in South Africa is under-researched. While there is some evidence indicating the positive HRQL outcomes on South African HIV-infected individuals accessing ART treatment, little is known about their sexual risk behaviour. Baseline data for a prospective cohort study of attendees not on treatment and recently initiating treatment at Cape Town public sector HIV services, showed no significant differences in reported condom use nor number and type of sexual partnerships in the past month in bivariate analyses of treatment status. Levels of sexual behaviour in the past month were high, with 59.7% of men and 62.3% of women reporting to have had at least one sexual partner (Eisele et al., 2008). Taking into account the variation in results found in studies both in developed and developing country settings discussed above, extrapolation to local context is problematic, and further context-specific research is required to understand and inform secondary prevention programmes in South Africa.

3 METHODS

3.1 Study setting

This analysis constitutes a sub-section of a broader study of the fertility intentions, contraceptive service needs and reproductive decision-making behaviour of HIV-infected women and men in Cape Town, South Africa. The objectives of the main study were to inform health service improvement for HIV-infected individuals by exploring fertility intentions, contraceptive choices and reproductive decision-making among these individuals, their partners and their communities. Furthermore, the main study explored health care provider attitudes towards the reproductive choices of HIV-infected individuals (Cooper et al., 2007, Harries et al., 2007, Orner et al., 2008). The study employed quantitative and qualitative methodology: 8 focus group discussions were held with HIV-positive men and women respectively; 4 in-depth interviews were held with HIV-infected men to explore treatment and care issues. A further 26 in-depth interviews were conducted among health care providers and health care managers and a quantitative cross-sectional survey was undertaken comprising 459 respondents. This mini-dissertation focuses exclusively on the analysis of variables of the cross-sectional survey, the methodology of which is described below.

Fieldwork was conducted at two public sector health facilities in the peri-urban community of Gugulethu, 18 km outside Cape Town. The suburban population was estimated to be 170 552 in the 2001 South African Census (Provincial Administration of the Western Cape, 2006). Formal and informal housing is relatively equally proportioned in this suburb, with 42% of dwellings being brick structures on separate stands (Provincial Administration of the Western Cape, 2006).

Two research sites, Gugulethu Day Hospital and Hannan Crusaid ARV Centre were selected for the study, each being primary-level facilities which together offer a range of healthcare services. Gugulethu Day Hospital offers curative and chronic services, as well as HIV testing for clinic attendees. The facility does not operate an antenatal or obstetric service, but the Gugulethu Midwife Obstetric Unit (MOU) is available to pregnant women on the same premises. This unit offers antenatal services 5 days per week and a 24 hour labour ward service. Women are offered VCT in pregnancy, and if found to be HIV-positive, they are offered PMTCT services. Furthermore, HIV-infected patients who are eligible for ART initiation (CD4 count $\leq$ 200 cells/μl) are referred from both the CHC and the MOU to Hannan Crusaid ARV Centre which operates as a separate facility on the same premises.

Ethical approval for the study was obtained from the University of Cape Town Research Ethics Committee and the Ethical Review Committee of the World Health Organisation (WHO).

Approval was obtained from local government health directorates for the use of Gugulethu Day Hospital and Hannan Crusaid ARV Centre.

Awareness of the sensitive nature of the research – notably the sexual behaviour and reproductive intentions of HIV-infected individuals – was taken into account, and all interviewers received thorough training in interviewing techniques, sexual and reproductive health issues and research sensitivity. Interviewers were available to all respondents for the duration of the fieldwork, and were obliged to assist in the referral of respondents to appropriate sources of clinical or psychological support upon request.

Written informed consent was obtained from each respondent prior to the interview. The consent document outlined the nature of the research, its purpose and the procedures involved, as well as the expected duration of the interview and potential risks and benefits of participation. Respondents were recruited without duress or undue influence. Compensation for cost of travel and light refreshments were offered for the time given for the interview.

The voluntary nature of respondent involvement, as well as the freedom to withdraw from the interview without prejudice was outlined in the informed consent procedure. Participant confidentiality was upheld through anonymous interviewing practices. No names were recorded during the interview process.

Participating in the questionnaire involved little risk to the respondent, due to the stringent adherence to ethical procedures for this research. While there was no direct benefit for involvement in the study, respondents contributed to the greater societal good: by sharing their experiences of and attitudes towards sexual behaviour in the context of HIV-infection, the collection of such data would serve to directly impact on the improvement of future health services for HIV-infected individuals as well as to inform prevention efforts against the secondary transmission of HIV.

3.2 Study population

The study population constituted all HIV-infected adults attending HIV-related services and Gugulethu Day Hospital (including the Gugulethu MOU) and Hannan Crusaid ARV Centre. Sample size calculation for PMTCT and VCT care respectively was based on an estimation that 2 000 men and women enrolled for each of these services annually. Since the primary focus of the study was to ascertain fertility intentions of HIV-infected individuals, the sample from PMTCT and VCT care was drawn based on the assumption that at least 50% of these clinic attendees would be sexually active but not be planning future children. A 10% margin of error, plus a further 10% over-sampling factor was added to this calculation, bringing the predicted sample size to be 85 men and women

from VCT and PMTCT services respectively, and 150 men and women from HIV care and ART services respectively (n=470).

3.3 Sampling

Systematic random sampling methods from the daily clinic registers ensured that the sample selected was representative of clinic attendees seeking PMTCT, VCT and HIV or ART care at each site. A total of 174 (38%) male and 285 (62%) female attendees (n=459) aged between 18 and 68 years were randomly selected from Gugulethu Day Hospital and MOU, and Hannan Crusaid. During each day of recruitment, fieldworkers generated a random number sequence to select patients from the daily list of attendees on the clinic registers for each service. From the HIV service, 6 men and 6 women were randomly selected every day. Over-sampling was applied to this service in order to attain the sample of ART patients, because no distinction was made in the register between those who were on treatment and those who were not. From the PMTCT service at the Gugulethu MOU, 4 post-partum women were randomly selected from the register of women waiting to attend the service on that day. Similarly for the VCT sample, 4 men and 4 women who were waiting for their HIV test results were randomly selected from the VCT register on the day.

Men and women attending the selected study sites were eligible for participation if they were 18 years or older and reported themselves to be HIV-infected. Respondents also had to be willing to have basic medical information extracted from their patient folder and agree to share with the interviewer certain aspects of HIV infection as per the questionnaire. Written informed consent for the use and sharing of this information was obtained from each participant prior to commencement of the interview.

Refusal to participate in the study was recorded for those who either declined the offer of participation extended by the clinic staff or for those who refused an interview upon meeting the interviewer, once the interviewer had imparted more information about the study. The age, sex and service attended of each refusal were collected in order to inform the assessment of non-response bias. The response rate was 93%. Of the 489 candidates approached, 459 of these provided informed consent and successfully completed the interview. In total, 30 (7%) of respondents declined the interview, on grounds of either being too ill or being time constrained. A total of 459 interviews were retained for subsequent analysis.

Respondents were recruited between May and September 2006. All interviews were face-to-face and conducted by four trained field work staff, each of whom had previous experience in working with HIV-infected individuals. Same sex interviews were conducted in the mother tongue

of the respondent (isiXhosa), in a private room provided by the respective health care sites. Respondents were reimbursed for transport costs.

3.4 Measurement

A standardized interviewer-administered structured questionnaire was used. The response format comprised a combination of closed and open questions. Each closed question yielded mutually exclusive, dichotomized or multi-item response categories. Categories were scaled and numerically pre-coded. In order to anticipate unknown responses, an 'other' category was assigned in some questions where appropriate. Open questions were included for probing purposes to enrich the content of certain closed questions pertaining to attitudes and beliefs.

The questionnaire was translated into isiXhosa and back-translated into English to ensure thematic coherence. A small pilot study was conducted to assess the instrument's sensitivity and appropriateness to content and adequacy of field worker training, as well as to pre-empt design failure.

Interviews were conducted in the clinic by trained field workers. For each interview, randomly selected candidates were approached by the health care provider or counsellor immediately after the consultation. Information about the study was given by the clinic staff before candidates were asked whether they were prepared to participate. Upon agreement, respondents were led to a private room to meet the interviewer, and an interview was either conducted immediately or scheduled for a time convenient to the respondent.

The instrument included questions arising from the following six themes:

3.4.1 Measurement of socio-demographic characteristics

Socio-economic data were collected on participants, including age, sex, level of education attained and employment status, income, housing type and household size and parity.

3.4.2 Measurement of sexual risk behaviour

Sexual risk behaviour was measured by determining intimate partnerships and sexual activity among participants. Sexual activity was defined as penetrative vaginal or anal intercourse. Participants were defined as being sexually active if they had engaged in sexual activity in the past month. Descriptions of current sexual relationships where applicable, number of sexual partners in the last 6 months, frequency of sexual intercourse in the past month and condom use in the past six months was collected. Furthermore, data on self-reported sexual activity and number of sexual partners were measured pre- and post-HIV diagnosis and post-ART initiation where appropriate.

3.4.3 Measurement of HIV infection and antiretroviral treatment status

The instrument collected data on time since HIV diagnosis, current ARV treatment use, and the duration on treatment.

3.4.4 Contraception and dual method use

Contraception and dual method use assessed such use before and after HIV diagnosis and after ART initiation.

3.4.5 Health status and health-related quality of life

Measures of health status included self-reported descriptions of clinical disease staging and CD4 cell count. To measure a subjective response to health-related quality of life, two measures were used. First, a visual analogue scale (VAS) was incorporated as a self-rating measure of health status. This psychometric measure was based on the Euro-Qual visual analogue scale (EQ VAS) (The EuroQol Group, 1990). The EQ VAS constitutes a part of a standardized measure of health status, the EQ-5D, which was developed by the EuroQoL Group, and has been validated in many settings, including South Africa. The EQ VAS scale is calibrated from 0 to 100, where 0 represents the worst and 100 represents the best imagined self-rated health status score. Individuals are asked by the interviewer to rate their health status on the day of the interview, and the results of this measure are used as an evaluation of the participant's overall health status (Oppe et al., 2007).

Second, an adapted, unofficial version of the EQ-5D descriptive system (The EuroQol Group, 1990), a five-dimension measure a respondent's subjective health state was used. Four of the original five dimensions of this measure were incorporated in the questionnaire, and comprised three self-rated levels (no problems, some problems, extreme problems) on the dimensions of pain and/or discomfort; usual activities; mobility and anxiety and/or depression respectively.

3.4.6 Psycho-social impact of HIV-infection

Data were gathered on participant disclosure status, their experiences of stigma and the perceived reactions of others to their HIV-positive status.

3.5 Data management and quality control

All completed questionnaires were checked on a daily basis by the study co-ordinator. Queries and errors were clarified by the field workers within 2 days of the interview date.

A customized template was designed in Microsoft Access 2000, and data were captured by data capturers. Double entry was used for quality control purposes. No personal identifiers were

used in the data capture process. Data were transferred to STATA Release 10 (STATACorp, College Station, USA). Internal logic checks and frequency distributions were generated to identify problematic observations. Data queries were resolved against the original questionnaires. After completion of data capture and quality control, all questionnaires were stored in a secure file to protect respondent confidentiality.

3.6 Variables

3.6.1 Outcome variables: sexual risk behaviour

Sexual risk behaviour was defined by and assessed with three outcome variables: sexual activity in the past month; number of sexual partners in the past 6 months; and condom use at last sexual intercourse.

Sexual activity in the past month

First, sexual activity in the past month was deemed a useful proxy for being sexually active given the data to hand. Respondents were asked to respond to the following question, "Approximately how many times have you had sexual intercourse in the past month?" Observations that were missing were not included in the subsequent analyses (n=33). A binary variable was created from this question, this variable being divided into "No sexual intercourse in the past month" and "Any sexual intercourse in the past month".

Number of sexual partners in past 6 months

Second, sexual risk behaviour was measured in terms of multiple sexual partnerships, not restricting the analysis to only those who reported being sexually active in the past month. Respondents were asked the following question, "Approximately how many sexual partners have you had in the past six months?" Observations that were missing were excluded from subsequent analyses (n=4). The data were then coded to create a binary variable: "Low risk sexual behaviour" (None or one sexual partner in the past six months) and "High risk sexual behaviour" (more than one sexual partner in the past six months). Concurrent sexual partnerships were not examined in this study, as provision for such measurement had not been made in the instrument.

Condom use at last sexual intercourse

Sexual risk behaviour was measured by looking at the reported use of a barrier method (either a male and/or female condom) at last sexual intercourse among respondents who reported to be sexually active in the past month. Respondents were asked the following question, "When you last had sexual intercourse, did you use a male or female condom?" The data were collected as a four level variable where levels 1 and 2 pertained to male and female condom use respectively, level 3 pertained to use of both male and female condoms, and level 4 denoted no condom use during last

sexual intercourse. A binary yes/no variable was created by grouping the first three levels together as condom use at last sexual intercourse, versus no condom use at last sexual intercourse.

3.6.2 Explanatory variables

Demographic and socio-economic status variables

The questionnaire covered items on respondent age, sex and home language. Age was collected as a continuous variable, and a categorical variable was created on three levels, notably participants under 25 years, 25-35 years and 35 years and older . Home language consisted of five categories: isiXhosa, isiZulu, Afrikaans and English, plus a category for other languages specified by the respondent. Since the home language of respondents was overwhelmingly isiXhosa, this variable was not included in the analysis.

Socio-economic status was investigated using type of residence, respondent employment status, monthly income and level of respondent education. Residence type was dichotomized into informal and formal housing status. Similarly, a dichotomous variable was created for employment status to represent those who were unemployed, versus those who were either employed or studying. A three-level variable for household monthly income (in current South African Rand) was created to include the following: under R1 000; R1 000 – R2 999 and R3 000 – R7 999. Educational level attained was described as a dichotomous variable ("Primary level education or less" and "Secondary level education or more").

Sexual activity

Variables describing sexual activity, which were supportive of the sexual risk behaviour outcome variables, included current sexual relationship status and duration of current sexual relationship.

A three-level variable was formed to describe current sexual relationship status from two existing variables in the dataset. The existing variables constituted a dichotomous variable describing whether or not the respondent was in a current sexual relationship, and a multiple-level variable that described the type of relationship which the respondent reported (married; unmarried but co-habiting; in a relationship but not co-habiting). The new variable described the following three categories: not in a relationship; in a non-cohabiting relationship and in a co-habiting relationship (including the assumption that married couples co-habited).

Similarly, a three-level variable was created to describe current sexual relationship duration. In this variable, observations who reported not to be in a relationship were included in order to maximize and retain the sample size in the multivariate regression analyses. Categories were thus: not in a relationship; in a relationship for three months or less, or in a relationship for more than three months.

Respondents in a current sexual relationship were asked whether their partner had parented a child with them. A dichotomous "yes/no" variable was created out of the question, "Is your current partner the parent of any of your children?" Observations which recorded "Not applicable" due to not having offspring, were dropped.

Respondents were asked to recall how frequently they had used a barrier method (male or female condom) over the past six months. Responses were coded into six categories, notably "Always"; "Most times", "Sometimes"; "Rarely", "Never" and "Not applicable". These categories were collapsed to form a new dichotomous variable describing "consistent condom use" (denoting 100% use) and "inconsistent condom use" (denoting less than 100% use) in participants declared to be sexually active in the last six months. Sexually abstinent observations that fell into the "Not applicable" category were dropped from this variable.

A question to ascertain the frequency of sexual intercourse after HIV diagnosis was asked. Respondents were requested to recall and compare whether they had sexual intercourse "more frequently"; "less frequently"; "as frequently" as pre-HIV diagnosis, or whether they had ceased to be sexually active since diagnosis. A new variable was coded for three levels to denote sexual intercourse since HIV diagnosis as "more frequent"; "about as frequent" and "less often or abstinent".

Similarly, participants who were on ART were asked to recall and compare whether they had sexual intercourse "more frequently"; "less frequently"; "as frequently" since ART initiation, or whether they had ceased to be sexually active since HIV diagnosis. A three-category variable was developed to describe responses to frequency of sexual intercourse since ART initiation as "more frequent"; "about as frequent" and "less often since initiation or abstinent since HIV diagnosis".

Respondents were asked to report numbers of sexual partners acquired since HIV diagnosis. A new dichotomous variable was formed to group reported sexual partner counts into "0 -1 partner" and "two or more partners". Similarly, another dichotomous variable was developed to categorize counts of sexual partners since ART initiation, each level denoting "0-1 partner" and "two or more" partners post-ART initiation.

Health status and treatment status

Three variables measured self-reported health status in relation to HIV. Respondents were asked to report time since HIV diagnosis in years and months. From this data, a variable for time since HIV diagnosis was created in months. This variable was dichotomised to denote those who had been diagnosed <12 months prior to the survey and those who had been diagnosed ≥ 12 months prior to the survey. In addition, respondents were asked to report their most recent CD4 cell count and WHO Stage. A three-level variable was created for CD4 cell count denoting the categories, 200

cells/μl or less; 350 cells/μl or less or more than 350 cells/μl. Data that were coded as "Missing" or "Don't know" were recoded as missing (n=85 (18.5%)). Similarly, a four-level variable was created to describe the four WHO stages. Data that were coded as "Missing" (n=163) or "Don't know" (n=98) were recoded as missing (n=261 (56.8%)).

Disclosure status

Respondents were asked about HIV disclosure status by answering seven disclosure options with yes/no answers. The options were not mutually exclusive and included disclosure to partner(s); family member(s); household members other than family; friends; other community members and health care providers other than those involved in HIV treatment and care. A summarized dichotomous variable describing disclosure status was developed from these seven categories, denoting two mutually exclusive categories: disclosed no-one or disclosed to someone. The sample size was too small to create categories that distinguished between partner disclosure and disclosure to individuals other than a partner.

Dual method use

Respondents were asked to recall their use of barrier and non-barrier contraceptive methods both before and after HIV diagnosis. Respondents on ART were asked to describe their contraceptive method usage after they had initiated treatment. All respondents were requested to describe which contraceptive methods they were currently using. Twelve separate variables were created to cover methods, which included modern methods such as the oral contraceptive pill (OC); two- or three-month injectable; intrauterine contraceptive device (IUD), female or male sterilization; male or female condom or the diaphragm. Recall of no method was also measured in this question. The use of twelve variables allowed for dual method use (the use of a contraceptive method in parallel with a barrier method, such as a male or female condom).

These variables were recoded to provide three composite dichotomous variables that described dual method use (yes/no) pre- and post-HIV diagnosis; dual method use among those on ART, and current dual method use.

Health-related quality of life

Respondents were asked to rate their level of pain and/or discomfort; ability to perform usual activities; mobility and anxiety and/or depression respectively. A three-level index score was developed for each of these four health states as follows, where the reference item denoted "No problems", the second item denoted "Some problems" and the third item denoted "Severe problems".

The EQ VAS scale consisting of self-reported health state scores between 0 and 100, was re-scaled to an index score between 0 and 3. This variable was then combined with the other four

HRQL three-level variables mentioned above, to produce a composite measure of HRQL, which had a range between 0 and 12. This composite scale was then divided into tertiles, to assist with ease of interpretation.

3.7 Response Rate

The response rate for socio-demographic and socio-economic items was high, with data being almost entirely complete. The response rate for data collected on the following variables rendered them sub-optimal for multivariate analyses, yet useful for descriptive measures and bivariate analyses: parenting within sexual partnerships (74% response rate, n=344); relationship duration (73% response rate, n=337); type of relationship (75% response rate, n=344); condom use at last sex (69%, n=319) and CD4 cell count (81% response rate, =374). Measures to increase sample size on relationship duration and relationship type were taken combining these variables such that they included a category for those who reported themselves to not be in a relationship.

3.8 Analysis

Data were analyzed using Stata Version 10.0 (Stata Corporation, College Station, USA). All observations (n=459) in the data set were included in the analysis.

3.8.1 Univariate and bivariate analyses

Descriptive statistics were produced on socio-demographic data, sexual activity, health-related HIV outcomes and treatment status, as well as HRQL scores in the whole sample, regardless of whether they declared themselves to be sexually active or not. All continuous variables were non-parametric, hence medians were described. The Wilcoxon rank-sum test was applied to test for significant differences in the equality of the probability distributions of samples of those who were not on treatment and those who were. Similarly, the Kruskal-Wallis test was used to test the equality of the probability distributions between samples from different service settings. Pearson χ^2 and Fisher's Exact tests were used to investigate the significance of any differences in the proportional distribution of the population over service settings and by treatment status.

Bivariate analyses were performed on socio-demographic, behavioural, health and HRQL variables. Pearson χ^2 and Fisher's Exact tests were used to test for the significance of an association of these predictors with sexual activity in the past month, condom use at last sexual intercourse among those who reported sexual activity in the past month, and number of partners, among those who were on ART and those who were not, as well as individuals attending different services. These analyses were stratified according to service attended and treatment status.

3.8.2 Multivariate analyses

Multivariate models were constructed using stepwise forward logistic regression analysis based on the log-likelihood ratio, to determine the predictors of sexual risk behaviour. First, a model was constructed to determine predictors of sexual activity in the past month. In a second model, factors associated with condom use at last sexual intercourse were examined among those who reported sexual activity in the past month. Those who claimed abstinence in the last month were not eligible for this analysis. A third model was developed to examine factors correlated with multiple partner acquisition over the past 6 months.

In all three models, explanatory variables associated with the outcome variable (sexual activity in the past month, condom use at last sex and multiple partner change over the past 6 months) with a p-value ≤ 0.05 in the bivariate analyses were introduced in stepwise fashion in the logistic models initially, as were variables with a p-value ≤ 0.1, based on a priori knowledge. Input variables included age, sex, type of residence, income, employment status and educational level attained. Self-reported health status variables included time since HIV diagnosis. As data concerning CD4 cell counts were missing for 19% of the respondents, this variable was not introduced into any of the models. Sexual risk behaviour variables were included in each model if they were deemed neither to predict the outcome variable perfectly nor be highly correlated with the outcome variable. HRQL variables pertaining to mobility, pain, feelings and daily activities were entered separately into each model, and in each instance compared to a model that incorporated only the VAS composite scale with other input variables. Variables were retained based on likelihood ratio test and goodness of fit test scores. Variables pertaining to disclosure, treatment status and type of service attended were forced in the model, even if they were not significant at the 5% level in either bivariate analyses or the model itself. The final three models were chosen based on the best Goodness of Fit test score, given the incorporation of the forced variables.

4 RESULTS

4.1 Description of sample

This survey collected data on 459 respondents. Of the women sampled, 20% (n=96) constituted PMTCT service attendees. Respondents from VCT services constituted 14% (n=64) of the sample, with 60% of these attendees being women. A greater proportion of men (62%, n=72) than women were sampled from HIV care services, which comprised 24% of the sample (n=111). Attendees from ART services made up 41% (n=188) of the sample, with 60% of these participants being female.

Table 1 compares the socio-demographic characteristics, health status and sexual behaviour of participants stratified by services and ARV treatment status respectively. The median age of the sample was 32 years (IQR 27-38 years) and 95% of respondents were 45 years or younger. Women constituted 62% of the sample, and were more likely than men to be 35 years or younger (OR 71.7, p<0.001). While 81% of respondents had completed some years in secondary school, only 22% of respondents claimed to be employed or studying and 78% lived in a household with a monthly income of R2 000-00 or less. There were small yet significant differences between services, and treatment naïve and experienced respondents.

Median time since HIV diagnosis was 12 months (IQR: 3-48 months) and for the 81% of the sample that reported a CD4 cell count, median CD4 cell count was 220.5 cells/μl (IQR: 95-370 cells/μl). Less than half of respondents recalled CD4 cell counts of 200 cells/μl or less. There were high rates of disclosure in the sample, but disclosure differed significantly between services and by treatment status, the lowest disclosure rate being evident in women attending PMTCT. Overall, 59% of respondents were not on ART at the time of interview yet among those who were accessing treatment, 56% (n=106) had been receiving treatment for more than 12 months.

In the sample, 32% (n=147) of respondents claimed that they had been abstinent in the past month. There was a significant difference in reported sexual activity between respondents accessing different services (p=0.002). Women attending PMTCT services reported the most sexual activity, with only 25% reporting to have been abstinent in the past month. Half of those attending HIV services reported abstinence, and one third of participants on ART claimed to have been abstinent in the past month. When stratifying by ARV treatment status, sexual activity was not significantly different between groups (p=0.685). Self-reported frequency of sexual activity post-HIV diagnosis was consistent with pre-diagnosis frequency. Data suggest that men were less than half as likely to have been sexually active in the past month as women (OR: 0.48, p=0.012).

Respondents reported a median frequency of 2 sexual acts over the past month, this frequency being significantly different across different services ($p<0.001$), with participants accessing PMTCT recalling a median of 3 sex events per month (IQR: 0.5-5) and VCT service attendees also recalling a median of 3 sex events per month (IQR: 0-4). Those in HIV care reported a median of only 1 sex act per month (IQR: 0-3). Frequency of sexual activity was not significantly different between groups, when stratifying by treatment status ($p=0.270$).

Furthermore, 95% of the respondents who reported sexual activity in the past month declared that they were currently in a sexual relationship ($p<0.001$). Only 5% of PMTCT service attendees suggested that they were not in a sexual relationship, while 30% of respondents on ART recalled that they were not in a relationship. Approximately a quarter of VCT service attendees (23%) and HIV care patients (26%) recalled that they were not in a sexual relationship respectively. Half of the respondents who had been sexually active, were in a cohabiting relationship with their sexual partner, cohabitation being associated with a 21-fold increase in relative risk of sexual activity when compared to respondents who were not in a relationship (OR: 21.12, $p<0.001$). Half of all women attending PMTCT services stated that they were in a non-cohabiting relationship, while approximately only a third of participants in VCT services (33%); HIV Care (33%) and ART treatment services (35%) respectively, stated that they were in a non-cohabiting relationship.

Consistent condom use over the last 6 months was significantly different between services ($p<0.001$), with only 31% of women attending PMTCT services recalling consistent use. Approximately half of VCT service (51%) and ART Care (52%) patients reported consistent condom use in the past 6 months, and 70% of HIV Care attendees reported consistent condom use. Whereas 70% of respondents on ART claimed to be using condoms consistently over the past 6 months, only 40% of respondents not on ART reported consistent condom use in the past 6 months ($p<0.001$). Of all respondents who reported sexual activity in the past month, 82% said that they had used a condom during their last sexual event. Condom use at last sex was lowest among PMTCT service attendees (72%) and highest among ARV-treated respondents (89%). Just over three quarters of VCT service attendees (76%) and HIV Care patients (78%) reported condom use at last sex. These differences were significant at service level ($p=0.017$).

Most respondents reported that they had not used a dual method contraceptive before HIV diagnosis and significant differences in dual method use prior to diagnosis were found between services ($p<0.001$) and by treatment status ($p<0.001$). Few respondents went on to use dual methods post-HIV diagnosis, the proportions varying significantly between services ($p<0.001$). Only 31% of respondents on ART reported dual method use after treatment initiation, but 70% reported consistent condom use over the past 6 months. An overwhelming majority of women attending

PMTCT services (95%) suggested that they were not currently using dual methods. Current dual method use was highest in the ART service attendees, with 31% affirmed use.

Among all respondents, 20% reported that they had not had a sexual partner in the last six months; while 67% reported having 1 partner and 13% reported having more than one partner in the last six months. There was a significant difference between the number of partners reported by men and women, and men were about 2.5 times as likely to have more than one partner than women ($p<0.001$). A significantly higher proportion of HIV Care attendees (21%) reported more than one sexual partner in the past 6 months than in other services, however, when stratified by treatment status, there was no significant difference between the frequency of partner acquisition among those who were treatment-naïve and those who were treatment experienced. PMTCT service attendees reported the highest proportion of single partnerships over the past 6 months: 95% suggested that they had had between 0 and 1 partner.

HRQL scores suggested that a high proportion of respondents did not experience moderate or severe problems relating to mobility, pain, the ability to perform usual daily activities or anxiety and depression. Significant differences in self-rated mobility and pain were found between services, with those attending HIV Care reporting the highest proportion of health-related problems across all domains. A higher proportion of respondents on treatment reported fewer problems associated with mobility than those who were not on treatment ($p=0.046$).

Table 1 Description of sample by service setting and ARV treatment status

		Total	PMTCT (%)	VCT (%)	HIV Care (%)	ART Care (%)	p-value	Non-ARV treated (%)	ARV-treated (%)	p-value
N		459	96	64	111	188		271	188	
%		100	20.9	13.9	24.2	41.0		59%	41%	
Age category	<25 years	62	34(35.4)	9(14.1)	9(8.1)	10(5.3)	<0.001	52(19.2)	10(5.3)	<0.001
	25-35 years	238	56(58.3)	56(50.5)	56(50.5)	97(51.6)		141(52)	97(51.6)	
	>35 years	159	6(6.25)	46(41.4)	46(41.4)	81(43.1)		78(28.8)	81(43.1)	
Sex	Female	285	96 (100)	38 (59.4)	39 (35.1)	112 (59.6)	<0.001	173(63.8)	112(59.6)	0.355
	Male	174	0 (0)	26 (40.6)	72 (66.1)	76(40.4)		98(36.2)	76(40.4)	
Residence type	Informal	227	51 (53.1)	30 (46.9)	52 (46.9)	94 (50)	0.798	133(49.1)	94(50)	0.846
	Formal	232	45 (46.9)	34 (53.1)	59 (53.2)	94 (50)		138(50.9)	94(50)	
Income	R0-R999-00	203	24(27.0)	24(38.7)	64(60.4)	91(49.7)	<0.001	112(43.6)	91(49.7)	0.434
	R1 000-R 2 999	220	58(65.2)	37(59.7)	40(37.7)	85(46.5)		135(52.5)	85(46.5)	
	R3 000-R7 999	17	7(7.9)	1(1.6)	2(1.9)	7(3.8)		10(3.9)	7(3.8)	
Employment	Unemployed	355	69 (71.9)	44 (68.8)	90 (81.1)	152 (81.3)	0.075	203(74.9)	152(81.3)	0.108
	Working or studying	103	27 (28.1)	20 (31.3)	21(18.9)	35 (18.7)		68(25.1)	35(18.7)	
Education	None/primary	82	6(6.3)	13(2.3)	24(21.6)	39(20.7)	0.011	43(15.9)	39(20.7)	0.180
	Secondary/tertiary	377	90(93.8)	51(79.7)	87(78.4)	149(79.3)		228(84.1)	149(79.3)	
In a current relationship	No	103	5(5.2)	15(23.8)	29(26.8)	54(29.8)	<0.001	49(18.4)	54(29.8)	0.005
	Yes	345	91(94.8)	48(76.2)	79(73.2)	127(70.2)		218(81.7)	127(70.2)	
Type of relationship	Not in a relationship	103	5(5.2)	15(23.8)	29(26.9)	54(29.8)	<0.001	49(18.4)	54(29.8)	0.018
	Cohabiting	174	41(42.7)	27(42.9)	43(39.8)	63(34.8)		111(41.6)	63(34.8)	
	Non-cohabiting	171	50(52.1)	21(33.3)	36(33.3)	64(35.4)		107(40.1)	64(35.4)	
Relationship duration	Not in a relationship	103	5 (5.21)	15 (23.8)	29 (26.9)	54 (29.8)	<0.001	49 (18.4)	54 (29.8)	0.001
	In a relationship ≤ 3 months	154	49 (51.0)	24 (38.1)	36 (33.3)	45 (24.9)		109 (40.8)	45 (24.9)	
	In a relationship > 3months	191	42 (43.8)	24 (38.1)	43 (39.8)	82 (45.3)		109 (40.8)	82 (45.3)	
Child shared (current partner)	No	115	27(50)	19(48.7)	22(34.4)	47(42.7)	0.315	68(43.3)	47(42.7)	0.924
	Yes	152	27(50)	22(34.4)	47(42.7)	115(43.1)		89(56.7)	63(57.3)	
Sexually active in past month	No	147	24(25)	16(27.1)	52(49.1)	55(33.3)	0.002	92(35.3)	55(33.3)	0.685
	Yes	279	72(75)	43(72.9)	54(50.9)	110(66.7)		169(64.8)	110(66.7)	

Table 1 Description of sample by service setting and ARV treatment status (cont)

		Total	PMTCT (%)	VCT (%)	HIV Care (%)	ART Care (%)	p-value	Non-ARV treated (%)	ARV-treated (%)	p-value
Median sex acts in the past month		2	3	3	1	2	<0.001	2	2	0.270
	IQR	(0-4)	(0.5-5)	(0-4)	(0-3)	(0-3)		(0-4)	(0-3)	
Condom use at last sex	No	61	21(28)	11(23.4)	15(21.7)	14(10.9)	0.017	47(24.6)	14(10.9)	0.002
	Yes	258	54(72)	36(76.6)	54(78.3)	114(89.1)		144(75.4)	114(89.1)	
Condom use in past 6 months	Consistent use	199	28(31.5)	50(51.6)	99(70.7)	199(52.1)	<0.001	100(41.3)	99(70.7)	<0.001
	Inconsistent use	183	61(68.5)	47(48.5)	41(29.3)	183(47.9)		142(58.7)	41(29.3)	
Sexual partners in last 6 months	0-1 partner	397	91(95.8)	58 (90.6)	87 (78.4)	161 (87.0)	0.002	236 (87.4)	161 (87.0)	0.905
	2 or more partners	58	4 (4.2)	6 (9.4)	24 (21.6)	24 (13.0)		34 (12.6)	24 (12.6)	
Median time since HIV diagnosis (months)		12	3	7	12	36	<0.001	4	36	<0.001
	IQR	(3-48)	(1-7.5)	(1-36)	(3-24)	(12-60)		(1-24)	(12-60)	
Knowledge of serostatus	≤12 months	245	75(78.1)	41(64.1)	74(66.7)	55(29.3)	<0.001	190(70.1)	55(29.3)	<0.001
	>12 months	214	21(21.9)	23(35.9)	37(33.3)	133(70.7)		81(29.9)	133(70.7)	
CD4 cell count	≤ 200 cells/µl	168	16(16.7)	19(47.5)	56(72.7)	77(47.8)	<0.001	91(42.7)	77(47.8)	0.455
	≤350 cells/µl	106	34(35.4)	11(27.5)	15(19.5)	46(28.6)		60(28.2)	46(28.6)	
	>350 cells/µl	100	46(47.9)	10(25)	6(7.8)	38(23.6)		62(29.1)	38(23.6)	
Disclosure status	Did not disclose to someone	37	26(27.1)	4(6.3)	4(3.6)	3(1.6)	<0.001	34(12.6)	3(1.6)	<0.001
	Disclosed to someone	422	70(72.9)	60(93.8)	107(96.4)	185(98.4)		237(87.5)	185(98.4)	
Frequency of sex post-HIV diagnosis	More frequently	11	0(0)	7(10.9)	3(2.7)	1(0.5)	<0.001	10(3.7)	1(0.5)	0.012
	Less frequent/no sex	77	23(24)	12(18.8)	18(16.2)	24(12.9)		53(19.6)	24(12.9)	
	About the same frequency	369	73(76)	45(70.3)	90(81.1)	161(86.6)		208(76.8)	161(86.6)	
New sexual partners post-HIV diagnosis	0-1 partner	394	90 (93.8)	59 (92.2)	92 (82.9)	153 (81.4)	0.012	241 (88.9)	153 (81.4)	0.023
	2 or more partners	65	6 (6.3)	5 (7.8)	19 (17.1)	35 (18.6)		30 (11.1)	35 (18.6)	
Dual method use pre- HIV diagnosis	No	412	75(78.1)	57(89.1)	103(92.8)	177(94.2)	<0.001	235(86.7)	177(94.2)	0.010
	Yes	47	21(21.9)	7(10.9)	8(7.2)	11(5.9)		36(13.3)	11(5.9)	
Dual method use post-HIV diagnosis	No	354	87(90.6)	45(70.3)	90(81.1)	132(70.2)	<0.001	222(0)	132(0)	0.003
	Yes	105	9(9.4)	19(29.7)	21(18.9)	56(29.8)		49(18.1)	56(29.8)	
Current dual method use	No	353	92(95.8)	47(73.4)	86(77.5)	128(68.1)	<0.001	225(83)	128(68.1)	<0.001
	Yes	106	4(4.2)	17(26.6)	25(22.5)	60(31.9)		46(17)	60(31.9)	

Table 1 Description of sample by service setting and ARV treatment status (cont)

		Total	PMTCT (%)	VCT (%)	HIV Care (%)	ART Care (%)	p-value	Non-ARV treated (%)	ARV-treated (%)	p-value
HRQL – Mobility	No problems	237	55(57.3)	32(50)	41(36.9)	109(58.3)	0.011	128(47.2)	109(58.3)	0.046
	Some problems	205	37(38.5)	29(45.3)	65(58.6)	74(39.6)		131(48.3)	74(39.6)	
	Severe problems	16	4(4.2)	3(4.7)	5(4.5)	4(2.1)		12(4.4)	4(2.1)	
HRQL - Usual activities	No problems	373	78(81.3)	54(84.4)	81(73)	160(85.6)	0.139	213(78.6)	160(85.6)	0.097
	Some problems	81	18(18.8)	9(14.1)	29(26.1)	25(13.4)		56(20.7)	25(13.4)	
	Severe problems	4	0(0)	1(1.6)	1(0.9)	2(1.1)		2(0.7)	2(1.1)	
HRQL - Pain/Discomfort	No problems	267	62(64.6)	34(53.1)	50(45.1)	121(64.7)	0.025	146(53.9)	121(64.7)	0.067
	Some problems	164	29(30.2)	25(39.1)	54(48.7)	56(30)		108(39.9)	56(30)	
	Severe problems	27	5(5.2)	5(7.8)	7(6.3)	10(5.4)		17(6.3)	10(5.4)	
HRQL - Anxiety/Depression	No problems	366	77(80.2)	49(77.8)	89(80.2)	151(80.8)	0.996	215(79.6)	151(80.8)	0.947
	Some problems	74	16(16.7)	11(17.5)	18(16.2)	29(15.5)		45(16.7)	29(15.5)	
	Severe problems	17	3(3.1)	3(4.8)	4(3.6)	7(3.7)		10(3.7)	7(3.7)	
HRQL - Composite VAS scale - tertiles	1	329	64(66.7)	43(68.3)	84(75.7)	138(73.8)	0.545	191(70.7)	138(73.8)	0.424
	2	123	31(32.3)	19(30.2)	27(24.3)	46(24.6)		77(28.5)	46(24.6)	
	3	5	1(1)	1(1.6)	0(0)	3(1.6)		2(0.7)	3(1.6)	
On ART	No	271	96(100)	64(100)	111(100)	0(0)	<0.001			
	Yes	188	0(0)	0(0)	0(0)	188(100)				

4.2 Determinants of sexual activity

Bivariate associations between sexual activity in the past month and potential predictors are presented in Table 2. Table 3 outlines the determinants of sexual activity, adjusted through multivariate logistic regression.

A total of 279 (61%) out of the 459 respondents declared themselves to be sexually active in the past month. In the bivariate analyses, the odds of sexual activity were lower in respondents aged 25 years and older (p=0.003). Respondents aged 25-35 years had an 18% reduced relative risk of having had sexual intercourse in the last month, while respondents over the age of 35 years had a 58% reduced risk of having had sexual intercourse in the last month. When adjusting for other factors in the multivariate analyses, age was not a significant predictor of sexual activity in this sample (Table 3).

Crude associations suggested that men were significantly less likely to have been sexually active in the past month than women (OR 0.42, p<0.001). Similarly, a strong association between respondent sex and sexual activity was observed with multivariate adjustment, with men being half as likely to have been sexually active in the past month as women (OR: 0.50, p=0.02).

In the bivariate analyses, respondents who had a monthly household income of R1 000-00 or more were more likely to have been sexually active in the past month than those earning less than R1 000-00. While similar trends were seen in the multivariate model, these results were not significant (p>0.1). Being either employed or a student was correlated with a significantly higher probability of sexual activity in the bivariate analysis (OR: 2.02, p=0.007). After statistical adjustment those who were employed or studying were less than twice as likely to be sexually active (OR: 1.77, p=0.06). The unadjusted association between educational level and sexual activity suggested an insignificant decrease in sexual risk with level attained (OR: 0.94, p=0.809). This decrease was more pronounced in the logistic regression, where respondents with a secondary or tertiary level education were almost half as likely to be sexually active (OR: 0.53, p=0.04).

Crude analyses suggested that condom use was significantly higher among sexually active respondents, who had a 2 fold increase in the relative risk of using a condom at last sex (OR: 2.17, p=0.04), and were 64% less likely to have used a condom inconsistently in the past 6 months (OR: 0.36, p<0.001). Furthermore, the unadjusted analyses shows that respondents who were sexually active were half as likely to report the use of a dual method pre-HIV diagnosis (OR 0.57, p=0.081), yet more than twice as likely to report dual method use at the time of interview (OR: 2.45, p=0.001).

The crude association between sexual activity and the type of service attended by respondents was highly significant (p=0.002), however, when entered into the multivariate model, the significance of this relationship fell away. Moreover, little difference was indicated in the sexual activity of respondents

on treatment versus those who were not on treatment in the bivariate analyses. This factor was dropped from the regression model due to high collinearity with the respondent's service attended, which also provided a better model fit in the likelihood ratio test.

The time since a respondent's HIV diagnosis, as well as disclosure status was not significantly associated with being sexually active in the past month in bivariate analyses. Based on a priori knowledge, these factors were forced in the multivariate model regardless, but no significant associations between these factors and sexual activity in the past month were rendered.

Unadjusted analyses of HRQL factors suggested that respondents who reported sexual activity in the past month were significantly less likely to report problems associated with mobility ($p=0.032$) or pain and discomfort ($p=0.043$) than those who stipulated that they had not been sexually active in the past month. The stepwise inclusion of HRQL factors in the regression analysis provided a poorer fit than the composite measure of the VAS scale in the likelihood ratio tests. The latter was forced in the final model, but suggested no significant association between HRQL and sexual activity.

Table 2 Bivariate analysis: sexual activity

		Sexual activity in past month				
		Total n=459	No n=147(%)	Yes n= 278 (%)	pvalue	OR (95% CI) unadjusted
Age	<25 years	62(13.5)	15(10.2)	43(15.4)	0.003	
	25-35 years	238(51.8)	68(46.3)	159(57)		0.82 (0.42-1.57)
	>35 years	159(34.6)	64(43.5)	77(27.6)		0.42 (0.21-0.82)
Sex	Female	285(62.1)	68(46.3)	188(67.4)	0.000	
	Male	174(37.9)	79(53.7)	91(32.6)		0.42 (0.28-0.63)
Residence type	Informal	227(49.5)	69(46.9)	146(52.3)	0.290	
	Formal	232(50.5)	78(53.1)	52.33(0)		0.81 (0.54-1.20)
Income	<R1 000	80(55.6)	80(55.6)	103(38.6)	0.004	
	R1 000 - R2 999	211(51.3)	60(41.7)	151(56.6)		1.95 (1.29-2.97)
	R3 000 - R 7 999	17(4.1)	4(2.8)	13(4.9)		2.52 (0.79-8.04)
Employment status	unemployed	327(76.8)	124(84.4)	203(72.8)	0.007	
	employed/studying	99(23.2)	23(15.7)	76(27.2)		2.02 (1.20-3.39)
Education level	0-primary level	78 (18.3)	26(33.3)	121(34.8)	0.809	
	secondary or more	348(81.7)	52(66.7)	227(65.2)		0.94 (0.56-.58)
In a current relationship	No	74	62(44.3)	12(4.3)	<0.001	
	Yes	344	78(55.7)	266(95.7)		17.62 (9.04-34.35)
Type of relationship	Not in a relationship	74(17.7)	62(44.2)	12(4.3)	<0.001	
	Cohabiting relationship	173(41.4)	34(24.3)	139(50.0)		21.12 (10.25-43.52)
	Non-cohabiting relationship	171(40.9)	44(31.4)	127(45.7)		14.91 (7.35-30.24)
Relationship duration	Not in a relationship	74(17.7)	62(44.3)	12(4.3)	<0.001	
	In a relationship <= 3 months	154(36.8)	32(22.9)	122(43.9)		19.70 (9.49-40.89)
	In a relationship > 3 months	190(45.5)	46(3.9)	144(51.8)		16.17 (8.02-32.62)
Shares a child with current partner	No	115	12(18.5)	103(51.2)	<0.001	
	Yes	151	53(81.5)	98(48.8)		0.91 (0.73-1.14)
Number of sexual partners in the last 6 months	0-1 partner	365	132(89.8)	233(84.4)	0.126	
	>1 partner	58	15(10.2)	43(15.6)		1.62 (0.87-3.04)
Condom use at last sex	No	59	12(30.8)	47(17)	0.040	
	Yes	256	27(69.2)	229(83)		2.17 (1.02-4.58)
Frequency of condom use in last 6 months	Consistent use	198	35(34)	163(58.8)	<0.001	
	Inconsistent use	182	68(66)	114(41.2)		0.36 (0.22-0.58)
Service attended	PMTCT	96	24(16.3)	72(25.8)	0.002	
	VCT	59	16(10.9)	43(15.4)		0.90 (0.43-1.87)
	HIV Care	106	52(35.4)	54(19.4)		0.35 (0.19-0.63)
	ART Care	165	55(37.4)	110(39.4)		0.67 (0.38-1.17)
Sexual activity post-HIV diagnosis	More frequently	11	3(2.1)	8(2.9)	0.077	
	Less frequently	76	18(12.3)	58(20.8)		
	About the same frequency	338	125(85.6)	213(76.3)		0.64 (0.17-2.45)
Number of new sexual partners post-HV diagnosis	0-1 partner	363	124(84.4)	239(85.7)	0.717	
	>1 partner	63	23(15.7)	40(14.3)		0.90 (0.52-1.57)

Table 2 Bivariate analysis: sexual activity (cont)

		Sexual activity in past month				
		Total n=459	No n=147(%)	Yes n= 278 (%)	pvalue	OR (95% CI) unadjusted
Dual method use before HIV diagnosis	No	383	127(86.4)	256(91.8)	0.081	
	Yes	43	20(13.6)	23(8.2)		0.57 (0.30-1.08)
Dual method use after HIV diagnosis	No	324	119(81)	205(73.5)	0.086	
	Yes	102	28(19.1)	74(26.5)		1.53(0.94-2.50)
Dual method use post-ART initiation	No	360	134(91.2)	226(81)	0.006	
	Yes	66	13(8.8)	53(19)		2.42 (1.27-4.60)
Current dual method use	No	324	126(85.7)	198(71)	0.001	
	Yes	102	21(14.3)	81(29)		2.45 (1.45-4.17)
Time since HIV diagnosis	0-12 months	235(55.2)	87(59.2)	148(53.1)	0.226	
	>12months	191(44.8)	60(40.8)	131(47.0)		1.28 (0.86-1.92)
CD4 count recall	<=200 cells/µL	155(36.4)	59(40.1)	96(34.4)	0.467	
	<=350 cells/µL	97(22.8)	30(20.4)	67(24.0)		1.37 (0.80-2.35)
	>350 cells/µL	174(40.9)	58(39.5)	116(41.6)		2.17 (1.21-3.88)
Disclosure status	Did not disclose to someone	36	9(6.1)	27(9.7)	0.210	
	Disclosed to someone	390	138(93.9)	252(90.3)		0.61 (0.28-1.33)
On ART	No	261	92(62.6)	169(60.6)	0.685	
	Yes	165	55(37.4)	110(39.4)		1.09 (0.72-1.64)
Duration on ART	Not on ART	261(61.2)	92(62.6)	169(60.6)	0.566	
	On ART (0-11 months)	75(17.6)	28(19.1)	47(16.9)		0.91 (0.54-1.56)
	On ART (12 or more months)	90(21.1)	27(18.3)	63(16.9)		1.27 (0.76-2.13)
Sexual activity post-ART initiation	More frequently	14	2(4.2)	12(10.5)	0.014	
	Less frequently	36	5(10.4)	31(27.2)		1.03 (0.18-6.07)
	About the same frequency	112	41(85.4)	71(62.3)		0.29 (0.06-1.35)
Number of sexual partners post-ART initiation	0-1 partner	138	48(96)	90(90.9)	0.262	
	>1 partner	11	2(4)	9(9.1)		2.4(0.49-11.55)
Quality of life - mobility	No problems	222(52.1)	67(45.6)	155(55.6)	0.032	
	Some problems	191(44.8)	72(49.0	119(42.7)		0.71 (0.47-1.08)
	Confined to bed	13(3.1)	8(5.4)	5(1.8)		0.27 (0.09-0.86)
Quality of life - pain or discomfort	No pain/discomfort	249(58.4)	78(53.1)	171(61.3)	0.043	
	Moderate pain/discomfort	154(36.2)	56(38.1)	98(35.1)		0.80 (0.52-1.22)
	Extreme pain/discomfort	3(5.4)	13(8.8)	10(3.6)		0.35 (0.15-0.83)
Quality of life - feelings	No anxiety/depression	341(80.2)	116(79.5)	225(80.7)	0.392	
	Moderate anxiety/depression	68(16.0)	22(15.1)	46(16.5)		1.08 (0.62-1.88)
	Extreme anxiety/depression	16(3.7)	8(5.5)	8(2.9)		0.52 (0.19-1.41)
Quality of life - execution of daily activities	No problem	349(81.9)	113(76.9)	236(84.6)	0.102	
	Some problems	74(174)	32(21.8)	42(15.1)		0.63 (0.38-1.05)
	Severe problems	3(0.7)	2(1.36)	1(0.4)		0.24 (0.02-2.67)
Quality of life scale (tertile)	1	166	59(40.1)	107(38.4)	0.152	
	2	125	35(23.8)	90(32.3)		1.42 (0.86-2.35)
	3	426	53(36.1)	82(29.4)		0.85 (0.53-1.36)

Table 3 Multivariate analysis: sexual activity in the last month

Variable	Odds Ratio	p- value	95% CI
Age 25-35 years (Ref: Age <25years)	0.92	0.84	(0.43-1.97)
Age >35 years	0.49	0.11	(0.21-1.16)
Male (Ref: Female)	0.50	0.02	(0.28-0.90)
Income R1000 - R2999 (Ref: Income <R1 000)	1.38	0.19	(0.86-2.22)
Income >R3000	1.51	0.54	(0.41-5.57)
Employed or Studying (Ref: Unemployed)	1.77	0.06	(0.98-3.18)
Secondary or tertiary education (Ref: no education/primary)	0.53	0.04	(0.29-0.96)
Time since HIV diagnosis >12 months (Ref: ≤12 months)	1.36	0.21	(0.84-2.21)
Disclosed status to someone (Ref: Not disclosed)	0.76	0.55	(0.31-1.86)
Attending VCT (Ref: Attending PMTCT)	1.74	0.21	(0.73-4.17)
Attending HIV Care	0.71	0.38	(0.33-1.52)
Attending ART Care	1.17	0.68	(0.56-2.44)
VAS composite scale 2 (Ref: VAS composite scale 1)	1.55	0.12	(0.89-2.71)
VAS composite scale 3	0.67	0.16	(0.38-1.16)

4.3 Factors associated with barrier method use – condom use at last sex

Bivariate associations between condom use at last sexual intercourse are outlined in Table 4. None of the socio-demographic factors assessed were significantly associated with condom use at last sex event, apart from respondent's monthly income, which was significant at the 6% level. The multivariate model (Table 5) shows that income remained the strongest single predictor after statistical adjustment. Respondents who were earning more than R3 000 per month were 77% less likely to have used a condom at last sex than respondents earning less than R1 000 per month (p=0.06).

In the bivariate analyses, respondent's time since HIV diagnosis was significantly associated with condom use at last sex at the 10% level (p=0.099). Furthermore, respondents who had disclosed their HIV status to someone had more than a 2 fold increased relative risk of using a condom at last sex than those who had not disclosed their serostatus (p=0.018). There was a significant crude association between the respondent's service attended and condom use at last sex. (p=0.007), and those who were on ART had a three-fold increased relative risk of using a condom at last sex than those who were not on ART (p=0.002). In multivariate analysis, time since HIV diagnosis, disclosure status and service attended were forced in the model, however, none of these factors were significant predictors of condom use at last sex. Respondents on ART continued to have a three-fold increased relative risk of using a condom at last sex in the multivariate analysis (p=0.04).

HRQL factors failed to show a significant association with condom use in either bivariate or adjusted analyses.

Table 4 Bivariate analysis: condom use at last sex

		Condom use at last sex				
		Total (n=276)	No n=47(%)	Yes n=229(%)	p-value	OR (95% CI) unadjusted
Age	<25 years	43	9(19.2)	34(14.9)	0.219	
	25-35 years	158	30(63.8)	128(55.9)		1.13 (0.49-2.60)
	>35 years	75	8(17)	67(29.3)		2.22 (0.79-6.26)
Sex	Female	186	34(72.3)	152(66.4)	0.427	
	Male	90	13(27.7)	77(33.6)		1.32 (0.66-2.66)
Residence type	Informal	144	21(44.7)	123(53.7)	0.259	
	Formal	132	26(55.3)	106(46.3)		0.70 (0.37-1.31)
Income	<R1 000	102	13(29.6)	89(40.5)	0.069	
	R1 000 - R2 999	149	26(59.1)	123(55.9)		0.69(0.34-1.42)
	R3 000 - R 7 999	13	5(11.4)	8(3.6)		0.23 (0.07-0.82)
Employment status	unemployed	202	34(72.3)	168(73.4)	0.885	
	employed/studying	74	13(27.7)	61(26.6)		0.95 (0.47-1.92)
Education level	None/primary	49	6(12.8)	43(18.8)	0.326	
	Secondary/tertiary	227	41(87.2)	186(81.2)		0.63 (0.25-1.59)
In a current relationship	No	12	3(6.4)	9(4)	0.433	
	Yes	263	44(93.6)	219(96.1)		1.66 (0.43-6.38)
Type of relationship	Not in a relationship	12	3(6.4)	9(4)	0.578	
	Cohabiting relationship	136	25(53.2)	111(48.7)		1.48 (0.37-5.86)
	Non-cohabiting relationship	127	19(40.4)	108(47.4)		1.89 (0.47-7.64)
Relationship duration	Not in a relationship	12	3(6.4)	9(4)	0.458	
	In a relationship ≤3 months	122	23(48.9)	99(43.4)		1.43 (0.36-5.72)
	In a relationship > 3 months	141	21(44.7)	120(52.6)		1.90 (0.48-7.62)
Child shared (current partner)	No	103	20(71.4)	83(48.8)	0.040	
	Yes	95	8(28.6)	87(51.2)		2.62. (1.09-6.28)
Number of sexual partners in the last 6 months	0-1 partner	231	44(93.6)	187(82.7)	0.074	
	>1 partner	42	3(6.4)	39(17.3)		3.06 (0.90-10.35)
Service attended	PMTCT	72	19(40.4)	53(23.1)	0.007	
	VCT	41	10(21.3)	31(13.5)		0.23 (0.46-2.69)
	HIV Care	54	9(19.2)	45(19.7)		1.29 (0.74-4.35)
	ART Care	109	9(19.2)	100(43.7)		3.15 (1.69-9.41)
Time since HIV diagnosis	0-12 months	146	30(63.8)	116(50.7)	0.099	
	>12months	130	17(36.2)	113(49.3)		1.72 (0.90-3.29)
CD4 count recall	<=200 cells/μL	93	17(43.6)	76(39)	0.847	
	<=350 cells/μL	67	10(25.6)	57(29.2)		1.28 (0.54-2.99)
	>350 cells/μL	74	12(30.8)	62(31.8)		1.16 (0.51-2.60)
Disclosure status	Did not disclose to someone	27	9(19.2)	18(7.9)	0.018	
	Disclosed to someone	249	38(80.9)	211(92.1)		2.78 (1.16-6.64)
Frequency of condom use in last 6 months	Consistent use	163	3(6.5)	160(69.9)	<0.001	
	Inconsistent use	112	43(93.5)	69(30.1)		0.03 (0.01-0.10)
Frequency of sex post-HIV diagnosis	More frequently	8	3(6.4)	5(2.2)	0.140	
	Less frequently	58	12(25.5)	46(20.1)		2.30 (0.48-11.01)
	About the same frequency	210	32(68.1)	178(77.7)		3.34 (0.76-14.66)

Table 4 Bivariate analysis: condom use at last sex (cont)

		Condom use at last sex				
		Total (n=276)	No n=47(%)	Yes n=229(%)	p-value	OR (95% CI) unadjusted
Number of new sexual partners post-HV diagnosis	0-1 partner	236	41(87.2)	195(85.2)	0.712	
	>1 partner	40	6(12.8)	34(14.9)		1.19 (0.47-3.02)
Dual method use before HIV diagnosis	No	253	44(93.6)	209(91.3)	0.776	
	Yes	23	3(6.4)	20(8.7)		1.40 (0.40-4.93)
Dual method use after HIV diagnosis	No	204	41(87.2)	163(71.2)	0.028	
	Yes	72	6(12.8)	66(28.8)		2.77 (1.12-6.83)
Dual method use post-ART initiation	No	57	9(100)	48(48)	0.003	
	Yes	52	0(0)	52(52)		
Current dual method use	No	197	43(91.5)	154(67.3)	0.002	
	Yes	79	4(8.5)	75(32.8)		5.24 (1.81-15.13)
On ART	No	167	38(80.9)	129(56.3)	0.002	
	Yes	109	9(19.2)	100(43.7)		3.27 (1.51-7.08)
Duration on ART	Not on ART	167	38(80.9)	129(56.3)	0.005	
	On ART (0-11 months)	47	5(10.6)	42(18.3)		2.47 (0.91-6.69)
	On ART (12 or more months)	62	4(8.5)	58(25.3)		4.27 (1.46-12.53)
Sexual activity post-ART initiation	More frequently	12	0(0)	12(11.8)	0.445	
	Less frequently	31	2(18.2)	29(28.4)		0.00
	About the same frequency	70	9(81.8)	61(59.8)		0.00
Sexual partners post-ART initiation	0-1 partner	89	8(100)	81(90)	0.348	
	>1 partner	9	0(0)	9(10)		0.00
HRQL - Mobility	No problems	154	27(57.5)	127(55.5)	0.293	
	Some problems	117	18(38.3)	99(43.2)		1.17(0.61-2.24)
	Confined to bed	5	2(4.3)	3(1.3)		0.2 (0.05-2.00)
HRQL - Pain/Discomfort	No pain/discomfort	170	30(63.8)	140(61.1)	0.761	
	Moderate pain/discomfort	96	15(31.9)	81(35.4)		1.16 (0.59-2.28)
	Extreme pain/discomfort	10	2(4.3)	8(3.5)		0.86 (0.17-4.24)
HRQL - Anxiety/Depression	No anxiety/depression	223	37(78.7)	186(81.2)	0.725	
	Moderate anxiety/depression	45	8(17)	37(16.2)		0.92 (0.40-2.13)
	Extreme anxiety/depression	8	2(4.3)	6(2.6)		0.60 (0.12-3.07)
HRQL - usual activities	No problem	233	39(83)	194(84.7)	0.720	
	Some problems	42	8(17)	34(14.9)		0.85 (0.37-1.99)
	Severe problems	1	0(0)	1(0.4)		0
Quality of life scale (tertile)	1	106	17(36.2)	89(38.9)	0.684	
	2	90	18(38.3)	72(31.4)		0.76 (0.37-1.59)
	3	80	12(25.5)	68(29.7)		1.08 (0.48-2.42)

Table 5 Multivariate analysis: condom use at last sex

Variable	Odds Ratio	p- value	95% CI
Age 25-25 years (Ref: Age <25 years)	0.63	0.38	(0.23-1.76)
Age >35 years	1.08	0.91	(0.29-3.97)
Male (Ref: Female)	0.72	0.50	(0.28-1.87)
Income R1000- R2999 (Ref: <R1 000)	0.82	0.63	(0.38-1.80)
Income >R3000	0.26	0.06	(0.06-1.04)
>1 sex partner in past 6 months (Ref: 0-1 sex partner in past 6 months)	2.89	0.12	(0.77-10.81)
Time since HIV diagnosis >12 months (Ref: ≤12 months)	0.92	0.84	(0.42-2.03)
Disclosed status to someone (Ref: Not disclosed)	1.48	0.49	(0.48-4.49)
Attending VCT (Ref: Attending PMTCT)	0.88	0.82	(0.30-2.56)
Attending HIV Care	1.18	0.77	(0.38-3.70)
Attending ART Care	3.20	0.04	(1.03-9.95)
VAS composite scale 2 (Ref: VAS composite scale 1)	0.98	0.96	(0.43-2.22)
VAS composite scale 3	1.44	0.44	(0.57-3.59)

4.4 Multiple partners over the past 6 months

In Table 6 which depicts the crude analyses, the relative risk of having more than one partner in the past six months increased almost five-fold for men, when compared with women (OR: 4.90, p<0.001). The strength of this association held in the adjusted analyses (Table 7), where men were 3.48 times as likely as women to have had more than one partner in the last six months (p<0.001), making the respondent's sex the singularly the most significant predictor of multiple sexual partnerships in the past six months. In the bivariate analyses, secondary level education or higher was associated with a 52% decreased relative risk in acquiring two or more sexual partners in the past six months, however, this association was highly insignificant in the final logistic model (OR:0.72, p=0.35).

Bivariate analyses showed that there were significant differences in the probability of multiple partner acquisition in the past six months and service attended (p=0.002). Yet respondents on ART were no more likely to have more than more than one sexual partner in the past six months than those not on ART (OR: 1.03, p=0.905). Neither of these factors was significant in multivariate analysis, despite the service setting being forced in the model. Similarly, time since HIV diagnosis and disclosure status did not feature as significant predictors of multiple sexual partnerships in either the bivariate or multivariate analyses.

HRQL factors were not associated with increased probability of multiple sexual partnerships in bivariate analyses, however the composite measure of HRQL was significantly associated with multiple partner acquisition over six months. Respondents who claimed to fall in the third tertile of self-perceived health status were 55% more likely than those who fell into the lowest tertile of self-perceived health risk to have more than one new sexual partnership in the past six months (p=0.033). This association was maintained in adjusted analyses, where respondents in the second tertile were 49% more likely to acquire more than one sexual partner over the past six months than those who were in the lowest tertile (p=0.06).

Table 6 Bivariate analysis: number of sexual partners in last 6 months

		Sexual partners in the last 6 months				
		Total	0-1	>1	p- value	OR (95% CI) unadjusted
Age	<25 years	62	58(14.6)	4(6.9)	0.073	
	25-35 years	235	208(52.4)	27(46.6)		1.57(0.62-3.98)
	>35 years	158	131(33)	27(46.6)		2.53 (1.00-6.40)
Sex	Female	283	266(67)	17(29.3)	<0.001	
	Male	172	131(33)	41(70.7)		4.90 (2.68-8.95)
Residence type	Informal	224	190(47.9)	34(58.6)	0.126	
	Formal	231	207(52.1)	24(41.4)		0.65 (0.37-1.13)
Income	<R1 000	201	169(44.4)	32(57.1)	0.196	
	R1 000 - R2 999	219	197(51.7)	22(39.3)		0.59 (0.33-1.05)
	R3 000 - R 7 999	17	15(3.9)	2(3.6)		0.70 (0.15-3.23)
Employment status	unemployed	351	303(76.5)	48(82.8)	0.289	
	employed/studying	103	93(23.5)	10(17.2)		0.68 (0.33-1.39)
Education level	0-primary level	81	64(16.1)	17(29.3)	0.014	
	secondary or more	374	333(83.9)	41(70.7)		0.48 (0.25-0.89)
In a current relationship	No	103	89(22.9)	14(24.6)	0.786	
	Yes	342	299(77.1)	43(75.4)		0.91 (0.48-1.75)
Type of relationship	Not in a relationship	103	89(22.9)	14(24.6)	0.957	
	Cohabiting relationship	172	150(38.7)	22(38.6)		0.93 (0.45-1.91)
	Non-cohabiting relationship	445	149(38.4)	21(36.8)		0.90 (0.43-1.85)
Relationship duration	Not in a relationship	103	89(22.9)	14(24.6)	0.935	
	In a relationship <= 3 months	153	133(34.3)	20(35.1)		0.96 (0.46-1.99)
	In a relationship > 3 months	189	166(42.8)	23(40.4)		0.88 (0.43-1.80)
Shares a child with current partner	No	0	(0)	(0)	0.690	
	Yes	151	130(57.3)	21(53.9)		0.87 (0.44-1.72)
Frequency of condom use in last 6 months	Consistent use	196	165(50.8)	31(57.4)	0.366	
	Inconsistent use	183	160(49.2)	23(42.6)		0.77 (0.43-1.37)
Sexual activity post-HIV diagnosis	More frequently	11	9(2.3)	2(3.5)	0.097	
	Less frequently	77	62(15.7)	15(25.9)		1.09 (0.21-5.57)
	About the same frequency	366	325(82.1)	41(70.7)		0.57 (0.12-2.72)
Number of new sexual partners post-HV diagnosis	0-1 partner	391	360(90.7)	31(53.5)	<0.001	
	>1 partner	64	37(9.3)	27(46.6)		8.47 (4.57-15.71)
Dual method use before HIV diagnosis	No	408	352(88.7)	56(96.6)	0.065	
	Yes	47	45(11.3)	2(3.5)		0.28 (0.07-1.18)
Dual method use after HIV diagnosis	No	350	303(76.3)	47(81)	0.426	
	Yes	105	94(23.7)	11(19)		0.75 (0.38-1.51)
Dual method use post-ART initiation	No	117	102(63.4)	15(62.5)	0.935	
	Yes	68	59(36.7)	9(37.5)		1.04 (0.43-2.52)
Current dual method use	No	350	307(77.3)	43(74.1)	0.590	
	Yes	105	90(22.7)	15(25.9)		1.19 (0.63-2.24)
Time since HIV diagnosis	0-12 months	244	215(54.2)	29(50)	0.553	
	>12months	211	182(45.8)	29(50)		1.18 (0.68-2.05)

Table 6 Bivariate analysis: number of sexual partners in last 6 months (cont)

		Sexual partners in the last 6 months				
		Total	0-1	>1	p- value	OR (95% CI) unadjusted
CD4 count recall	<=200 cells/μL	167	142(42.9)	25(61)	0.067	
	<=350 cells/μL	106	96(29)	10(24.4)		0.59 (0.27-1.29)
	>350 cells/μL	99	93(28.1)	6(14.6)		0.37 (0.14-0.93)
Disclosure status	Did not disclose to someone	36	35(8.8)	1(1.7)	0.068	
	Disclosed to someone	419	362(91.2)	57(98.3)		5.51(0.74-41.01)
On ART	No	270	236(59.5)	34(58.6)	0.905	
	Yes	185	161(40.6)	24(41.4)		1.03 (0.59-1.81)
Duration on ART	Not on ART	270	236(59.5)	34(58.6)	0.823	
	On ART (0-11 months)	80	71(17.9)	9(15.5)		0.88 (0.40-1.92)
	On ART (12 or more months)	105	90(22.7)	15(25.9)		1.16 (0.60-2.23)
Sexual activity post-ART initiation	More frequently	14	11(7)	3(12.5)	0.141	
	Less frequently	35	28(17.8)	7(29.2)		0.92 (0.20-4.20)
	About the same frequency	132	118(75.2)	14(58.3)		0.44 (0.11-1.75)
Number of sexual partners post-ART initiation	0-1 partner	154	139(95.9)	15(71.4)	<0.001	
	>1 partner	12	6(4.1)	6(28.6)		9.27 (2.65-32.37)
Quality of life - mobility	No problems	236	206(51.9)	30(51.7)	0.718	
	Some problems	203	176(44.3)	27(46.6)		1.05 (0.60-1.84)
	Confined to bed	16	15(3.8)	1(1.7)		0.46 (0.06-3.59)
Quality of life - pain or discomfort	No pain/discomfort	266	232(58.4)	34(58.6)	0.965	
	Moderate pain/discomfort	162	141(35.5)	21(36.2)		1.02 (0.57-1.82)
	Extreme pain/discomfort	27	24(6.1)	3(5.2)		0.85 (0.24-2.99)
Quality of life - feelings	No anxiety/depression	50	314(79.3)	50(86.2)	0.432	
	Moderate anxiety/depression	6	67(16.9)	6(10.3)		0.56 (0.23-1.37)
	Extreme anxiety/depression	2	15(3.8)	2(3.5)		0.84 (0.19-3.77)
Quality of life - execution of daily activities	No problem	370	321(80.9)	49(84.5)	0.835	
	Some problems	81	72(18.1)	9(15.5)		0.82 (0.38-1.74)
	Severe problems	4	4(1)	0(0)		0
Quality of life scale (tertile)	1	173	142(35.8)	31(53.5)	0.033	
	2	136	122(30.7)	14(24.1)		0.53 (0.27-1.03)
	3	146	133(33.5)	13(22.4)		0.45 (0.22-0.89)
Service attended	PMTCT	95	91(22.9)	4(6.9)	0.002	
	VCT	64	58(14.6)	6(10.3)		2.35 (0.64-8.70)
	HIV Care	111	87(21.9)	24(41.4)		6.28 (2.09-18.83)
	ART Care	185	161(40.6)	24(41.4)		3.39 (1.14-10.08)

Table 7 Multivariate analysis: multiple partners in the past 6 months

Variable	Odds Ratio	P value	95% CI
Age 25-35 years (Ref: Age <25 years)	0.99	0.99	(0.30-3.28)
Age >35 years	0.99	0.99	(0.28-3.57)
Male (Ref: Female)	3.48	0.00	1.59-7.61)
Secondary or tertiary education (Ref: No education/primary)	0.72	0.35	(0.36-1.44)
Time since HIV diagnosis >12 months (Ref: ≤12 months)	1.30	0.42	(0.69-2.45)
Disclosed status to someone (Ref: Not disclosed)	3.82	0.21	(0.47-31.20)
Attending VCT (Ref: Attending PMTCT)	0.92	0.91	(0.22-3.84)
Attending HIV Care	1.99	0.29	(0.56-7.13)
Attending ART Care	1.13	0.85	(0.32-4.06)
VAS composite scale 2 (Ref: VAS composite scale 1)	0.51	0.06	(0.25-1.04)
VAS composite scale 3	0.68	0.33	(0.31-1.47)

4.5 Conclusion

The results above show high levels of sexual activity among this sample (61%). Men were half as likely as women to report sexual activity in the past month, and higher educational level was a significant predictor of decreased sexual activity. No significant differences in sexual activity were found between ARV-treated and treatment naïve participants or across health services. Furthermore, individuals who were on ARV treatment were three times as likely as those not on treatment to have used a condom during their last sexual event. Despite reporting lower levels of sexual activity, men were more than three times as likely to report more than one sexual partner in the past six months. These results are discussed in light of existing evidence in the following chapter.

5 DISCUSSION

This thesis set out to examine the levels and determinants of sexual activity in HIV-infected, ARV treatment-naïve and treatment-experienced individuals accessing different primary health care service settings in Cape Town in 2006. It sought to determine predictors of sexual risk behaviour – notably unprotected sex and multiple partner acquisition – with a particular focus on whether or not disclosure or treatment status and time since diagnosis had a significant influence on sexual behaviour. Furthermore, this thesis examined the significance of HRQL as a correlate of sexual risk behaviour.

5.1 Levels of sexual activity

Higher levels of sexual activity were observed in this sample than found in similar studies in other African country settings, which reported sexual abstinence in the previous six months to be on average 50% (Kennedy et al., 2007). In this study, about one third of participants reported sexual abstinence in the past month. These results concur with another Cape Town study of an HIV-infected sample both on and not on ART, where over 59.7% of men and 62.3% of women reported at least one sexual partner in the past month, with no significant differences being found between those on treatment and those not on treatment (Eisele et al., 2008). Extrapolating to population level, 47% of women respondents in the 2003 SADHS reported sexual activity in the past month (Department of Health et al., 2007). These results could suggest that sub-populations of HIV-infected South Africans may have higher levels of sexual activity than the general population, despite the maturing of the epidemic. Generalization is problematic, however. In a community survey of adults in a similar urban Cape Town setting with known high HIV prevalence, 93% of men and 94% of women had ever been sexually active, with 83% of men and 82% of women reporting that they were in a current sexual relationship (Boulle et al., 2008). Hence, such high levels of sexual activity could suggest potential regional differences or other exogenous factors play a role in determining levels of sexual activity.

Levels of sexual activity appeared to be almost uniform across treatment status, suggesting that being on ART has neither a negative or positive influence on sexual activity among HIV-infected individuals in this sample. The lack of effect of ARV treatment on frequency of sex is similar to that found in Kampala, Uganda as well as results from Eisele et al's Cape Town study (Bateganya et al., 2005, Eisele et al., 2008).

In this study, univariate analyses showed that pregnant women accessing PMTCT services showed the highest levels of sexual activity in the sample. Having tested in pregnancy, women attending this service also comprised those with the shortest duration since HIV diagnosis. Fewer women attending PMTCT services were in a cohabitating relationship or had used a condom consistently in the

past six months. Other data from South Africa, looking at teenage pregnancy, supports this finding, suggesting that pregnant women have sex more frequently than non-pregnant women, and may experience more coercive and dependent relationships than non-pregnant women (Jewkes et al., 2001).

5.2 Determinants of sexual activity

When adjusting for confounding factors, the sex of the respondent and level of education attained were the strongest predictors of sexual activity in the past month. Men were half as likely as women to report sexual activity, which is interesting in light of evidence from other research in Africa, where men have been found to be more sexually active than women (Moatti et al., 2003). Furthermore, those with a secondary or tertiary qualification were about as half as likely to have been sexually active in the past month. Possibly the results found here show the effect of communication campaigns on individuals who have more access to health promotion messages through educational channels. Time since diagnosis, disclosure status, and HRQL factors seemed not to have any bearing on sexual activity in this sample.

5.3 Barrier method use and multiple partner acquisition

Self-reported condom use at last sexual event was high (≥72%) among all respondents, regardless of service setting. However, reported condom use was significantly higher among those on treatment than those not on treatment, suggesting greater levels of awareness around safer sexual practice among treatment initiated individuals. It is thought that high levels of condom use in other studies among ART-treated patients could be attributed to treatment literacy and elevated awareness of safer sex practices, through regular exposure in health care settings (Moatti et al., 2003). Furthermore, a greater proportion of ART-initiated respondents reported consistent condom use over the past six months than ART-naïve respondents. This trend held in the multivariate analyses: when controlling for confounding factors, condom use at last sexual act was significantly associated with attending an ART service. Income was associated with condom use at the 10% level, again suggesting that people with access to an income, who by proxy, may be more educated and more likely to be employed, may have had more exposure to health messages about safer sexual practices.

These results add to other South African evidence that suggests different, multiple factors predicting unprotected sex among HIV-infected individuals within other study populations. In a study of rural and urban HIV-infected individuals, determinants of consistent condom use included urban residence, higher level of education and for women, disclosure status (Lurie et al., 2008). Eisele et al's study of treatment-naïve and treatment initiated HIV-infected respondents in a Cape Town urban setting suggested high levels of unprotected sex, irrespective of treatment status. Significant predictors

of unprotected sex at last sexual intercourse included undisclosed serostatus to sexual partner as well as an ambivalence concerning the need for barrier methods when using ART. The latter factor was also the singular significant predictor for unprotected sex at last sexual intercourse with casual sex partners (Eisele et al., 2008). Attitudes towards dual method use were not explored in this study. However, univariate analysis at service level did show significant differences in dual method use, with dual method use being significantly higher among participants accessing ART.

Multiple partner acquisition over the past six months differed between clinic settings. When stratifying by treatment status, however, there was no significant difference between those who were on treatment and those who were not. A higher proportion of ARV-treated respondents reported more sexual partners since diagnosis than those who were not on treatment, but when controlling for confounding factors, respondent sex was singularly the most significant predictor of multiple partner acquisition. Men had more than a 3-fold relative risk of having had more than one sexual partner in the past six months when compared to women. This finding is concurs with other South African evidence from community surveys, where the likelihood of men having more than one additional partner was reported to be greater than that of women (Boulle et al., 2008, Shisana et al., 2005).

5.4 The association between sexual risk behavior and ARV treatment

To summarise, no significant differences were found in levels of sexual activity between ARV-treated and treatment naïve respondents. As already stated above, individuals on ART were significantly more likely to have used a condom at last sex, however, no more likely than treatment naïve respondents to acquire more than one sexual partner in the past 6 months.

5.5 The association between sexual risk behavior and HIV diagnosis, disclosure status and HRQL

The time since HIV diagnosis and respondent's disclosure status were not significant predictors of condom use at last sex or multiple partner acquisition. This is an interesting finding in light of previous research into condom use among HIV-infected individuals. Olly et al found that unprotected sex at last encounter was associated with shorter duration of HIV infection and lack of disclosure (Olly et al., 2005). Increased wellbeing, interpreted from the composite measure of HRQL, was significantly associated with multiple partner acquisition. This suggests that those who felt "more well" were more likely to have more sexual partners.

5.6 Conclusion

The high levels of sexual activity among HIV-infected individuals seeking a range of primary health care services in Cape Town, and the failure to detect major differences in sexual risk taking apart from condom use at last sex between those on ARV treatment and ART-naïve patients, has several implications for policy. First, there is an imperative to both increase, and make more widely targeted, behavioural risk reduction efforts across primary health care services, that specifically address the sexual health of HIV-infected individuals. Within this, communication campaigns which are tailored to gender specific needs are important. The fact that women in this sample were more sexually active than men, yet men were likely to have more than one partner than women, is suggestive that both sexes would benefit from different health messages.

Second, more emphasis needs to be placed on the use of condoms among HIV-infected individuals who have not yet initiated treatment. Again, gender specific communication which takes account of the complexity of condom negotiation and use within sexual partnerships, is needed. Messages which promote and empower women to use self-protection through condom use are required. Tailored messages for pregnant women are imperative. Since these results show that women attending PMTCT services had the highest levels of sexual activity, and reported the highest levels of inconsistent condom use, it is important that they be exposed to interventions that allow them to protect their own health and the health of their unborn children.

Third, prevention messages need to underscore the need for sexually active individuals to avoid frequent sexual partner turnover. This message is particularly important for men, who are at greater risk of having more than one partner over time than women.

Fourth, to limit secondary transmission between HIV-infected partners and those of unknown status, behavioural interventions need to continue to promote population level HIV testing. The importance of both knowing one's serostatus and the sharing of results between partners should be highlighted, in order to limit secondary transmission risk. Furthermore, sexually active individuals need to be cautioned against having unsafe sex with partners of unknown HIV status.

In conclusion, there remains a strong need for better understanding of the factors which influence the sexual risk behaviour of HIV-infected individuals in order to enhance prevention efforts.

5.7 Limitations

Sexual risk behaviour encompasses a broad range of sexual activity, and the obstacles to achieving valid measures of this activity are well documented. Three factors have been identified as important weaknesses in this study. First, social desirability bias and recall bias may have played a significant role in measurement error. Self-reported recall of sexual activity can distort the prevalence and frequency of

sexual risk behaviour in such research. In general, the collection of sexual behaviour data has implicit challenges due to the private nature of sexual activity and its affiliation with moral, social, cultural and legal norms. These inherent features, which may be amplified by the stigma associated with HIV infection, give rise to measurement error and participation bias. Furthermore, there is no gold standard validity index for measuring such error and bias (Catania et al., 1990, Weinhardt et al., 1998). While steps were taken to minimize this bias through questionnaire design, question terminology and structure, the reliability of any sexual risk behaviour data has been shown to vary with several factors, including sex, age, ethnicity, the recall period and the number of previous sexual partners (Fenton et al., 2001). It is plausible that the measurement of sexual risk behaviour in this study has been subjected to such error and bias, due to respondents reporting inaccurately either due to discomfort or embarrassment, or because of inaccurate recall of past events.

Second, the use of a cross-sectional study design limits the ability to ascertain causal relationships between sexual risk behaviour and its correlates. Moreover, such surveys on sexual behaviour are not large enough to determine the prevalence of certain behaviours among sub-populations, such as HIV-infected clinic attendees (Fenton et al., 2001). Without repeated measures, it is not possible to identify and monitor trends and behaviour change over time.

Third, sexual behaviour can be measured with a variety of indicators as demonstrated in the abovementioned literature, some of which the design and content of the survey questionnaire did not cover. For instance, no provision was made for the measurement of certain known risk factors including the prevalence of concurrent sexual partnerships, transactional sex and crude determinants such as lifetime number of partners. Little data on the participants' partnerships themselves were collected, and it may have been useful to ascertain the age distribution of men and women in current sexual partnerships. Furthermore, misclassification of self reported exposure through the use of the generic term "sexual partner" did not allow for the distinction between paid, casual and non-casual sex partnerships. Also, this questionnaire had no content on substance use, which would have been useful in the examination of alcohol or drug use and its association with sexual risk behaviour. Furthermore, it is possible that the lack of association of HRQL factors with sexual risk behaviour arose due to poor specification in the instrument, and more sensitive measures of self-reported health and well-being may have elicited richer data.

As with most forms of sociological, anthropological or behaviour-based research, the ability to extrapolate these results across social and economic classes in the same city – let alone across time and space – is intrinsically limited. The literature referred to in Chapter 2 described the conclusions drawn in similar studies around the globe. A common thread running through those studies was that multiple socio-behavioural factors, as well as the phase of the epidemic itself, uniquely serve to determine HIV

transmission. Such discrepancies between epidemic settings are integral in the appropriate shaping of prevention efforts to target secondary transmission. Hence, caution should be exercised in generalizing these results to inform broader policy recommendations. Yet, with the growth of interest in this area of research, and the continued scale-up and expansion of HIV treatment and care services in this setting, common patterns and modalities might become visible when comparing the results of this study with other, similar, studies examining secondary transmission risk of individuals accessing HIV and ART services over time.

As the health of HIV-infected individuals who begin to access ART in South Africa becomes increasingly relevant, so the potential for more in-depth research into their sexual behaviour and reproductive health needs should be prioritized. More powerful designs which employ standardized tools and longitudinal data collection measures could potentially elicit richer information on this sub-population.

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